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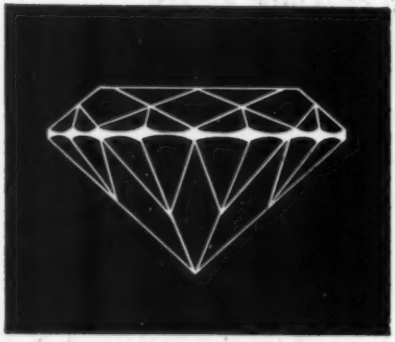

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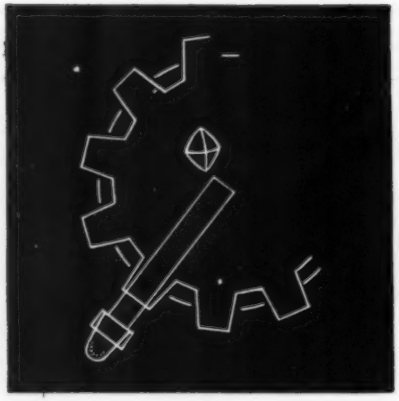

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Generally Speaking

Increases in the applications of industrial diamonds

The uses of industrial diamonds continue to increase with the development in all branches of the manufacturing industry of new techniques and new materials. Research, some deliberately directed towards this end by one or other branch of the diamond trade, and some arising simply from current requirements, is constantly widening this field still further. The position has been reached where it is practically impossible to think of any domestic or other object that has not been at some time directly or indirectly, subjected to diamond tool working. The modern hard metals and other harder materials, the alumina based ceramics and the cermets are almost wholly diamond worked, and their uses are becoming more and more widespread. Also scientific investigation itself is greatly served by diamonds. They are used as thermistors, as radiation detectors, and in a number of purely scientific ways.

Supply and demand

There is therefore no reason to expect other than an increase in demand for diamonds for industrial purposes, and as human vanity remains much the same through the ages, no greater reason to look for a recession in the demand for gems. The problem of supply by the end of the next twenty to twenty-five years will be governed by the discovery of new deposits or the extension of the known ones, to take the place of those that are likely to have reached the end of their economically workable life. More economic use of diamond tools, of course, is always worth investigation and much could be achieved by users making sure they fully understand the tools they have and keeping abreast of the many developments in the application of diamond tools.

N.B. The Exhibition Room at 2, Charterhouse Street, which has been closed for reconstruction, should be open by the beginning of June.

ADAMANT

*The Significance of Surface Finish On Friction, Wear and Lubrication**

by **A. Sonntag**

Introduction

At the 1940 Conference on 'Friction and Surface Finish' held at the Massachusetts Institute of Technology (MIT) A. M. Swigert[1] introduced his discussion thus:

> 'Down through the ages, but particularly during the past thirty years, has the striving for smoother bearing surfaces been prevalent. Engineers, regardless of what industry they were in, were constantly striving to produce finer surface finishes. At each forward step in the production of smoother surfaces there was always an increase in mechanical efficiency, useful life of product, quietness of operation, and in general, more satisfactory bearing characteristics. Therefore, it can be assumed that smoother bearing surfaces are preferable for the majority of operating conditions.'

What has happened in these past 19 years?

(1) In the art of producing smoother commercial finishes at reasonable cost considerable progress has been made.

(2) Experiences have been accumulating showing the smoothest surfaces quite frequently are not the best.

(3) Very little has been accomplished to reduce the complexity of surface geometry as it affects boundary lubrication and wear.

This paper attempts a general review of surface finish; how it is now defined and measured. Recent test data will be presented which may offer clues toward a better surface geometry for boundary friction, wear and lubrication.

The range of dimensional values

An ability to concentrate and think in small dimensions is the most essential requirement in evaluating the effect of surface finish in friction wear and lubrication. Dimensional values in research literature are expressed in Angstrom units, microinches and microns.

Table 1 shows conversions of these units of measure.

Table 1

Conversion table for small dimensional units

UNIT	Symbol	Conversions	
		in millimeters	in inches
1 Angstrom Unit	A or AU	0.1 millionth of a millimeter	0.003937 millionth of an inch
1 Microinch		0.0000254 mm 254 AU	1 millionth of an inch 0.00001"
1 Micron	μ	one thousandth of a millimeter 0.001 mm 10,000 AU	0.00003937" 39.4 microinches

The average human eye can barely see a wire 1,000 micro-inches in diameter. Yet, the essential details of surface geometry of greatest interest in friction wear and lubrication range from this dimension on downwards.

The most accurate and smoothest possible surface-molecular adhesion.

It is practical and useful to consider two mating surfaces, the accuracy and smoothness of which are in a range where certain characteristics of importance to friction wear and lubrication are convincingly apparent.

These may be called optimum surfaces where waviness and roughness are so small that all parts of the total mating areas are in the field of molecular attraction.

Surface irregularities would have to be reduced to the lattice spacing of the surface atoms, or about two to four Angstrom units (approximately 1/100 of a microinch).[2]

Assume that two such surfaces made of the same metal were produced and were kept free of all contamination such as oxides, gases or liquids. Upon mating, they would become one. It may be said that the entire bearing area in contact has cold welded together without the application of any pressure.

Although it has never been possible to verify this experimentally on a full-size bearing area

* Paper presented at the Seminar on Friction, Lubrication and Wear. Lucerne, Switzerland, September 17, 1959
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because such optimum bearing surfaces cannot be produced, atomic theory permits no other conclusion. Cold welding of perfectly clean surfaces in extremely small areas of contact has been demonstrated experimentally.[3]

The smoothest and the cleanest surfaces are, therefore, the worst possible ones in boundary friction.

On the bright side of human effort towards the optimum surface, one significant point deserves attention.

Molecular attraction forces diminish with the 6th power of distance and separation of the surfaces by about 1 AU reduces molecular forces to a negligible amount.

From this optimum base line of 1 AU lubricating contaminants could keep the bearing surfaces separated. The thinnest film of liquid separation measured in full hydrodynamic lubrication is about 4,000 AU (10 microinches).[4,5]

Thinner films will carry higher pressures and extend the range of hydrodynamic lubrication towards lower sliding velocities.

The very interesting work by L. F. Coffin, Jr.[4] shows some of the practical difficulties in perfecting surface accuracy by 'wear in' methods towards maintaining thinner liquid films between surfaces.

Molecular adhesion of less accurate surfaces

Cold welding by molecular adhesion using high pressures is now commercial practice on such ductile metals as aluminium, copper, cadmium, etc. Surfaces to be joined are cleaned but need not be exceptionally smooth. They are pressed together with a force large enough to produce yielding of the contracting surfaces to push the atom structure of one into intimate contact with the other. Small traces of surface oxides are so thinly dispersed that molecular adhesion of the bulk of the metals is assured and pressing surfaces together with the load high enough to merge one into the other plastically, dispenses with the need for surface accuracy. A number of dissimilar metals have also been joined by this method of cold pressure welding.[6]

Table 2 Terms and definitions used to describe surfaces

	Large Deviations From The True Plane of Design a)	Small Surface Irregularities	Direction of Surface Finish
Terms Used	Waviness, trueness, macro geometry	Roughness, micro geometry asperities	Uni-directional, multi-directional, cross hatch
Definitions	Waves the height of which exceeds 0.00002″ (0.005 mm). Differences in elevation from one square millimeter (0.04″) to another Waves the length of which on smooth machined surfaces may vary between 0.75 to 25 mm (0.03″ to 1″)	Differences in elevation within one square millimeter (0.04″) Surface roughness expressed in micro inches rms, micro inches CLA ot AA or in microns R	With reference to direction of motion : a) with direction of motion, also parallel to . . . b) across direction of motion, also traverse to . . .
Measuring Instrument Most Commonly used	Micrometers, dial indicators with spherical contact points of approx 1/8″ dia, tracer point instruments	Tracer instruments with diamond or sapphire points of . . . radius 0.0001″ to 0.0005″ (0.0025-0.0127 mm)	Visual and microscope
Other Measuring Instruments and Methods	Visual after short period of ring lapping or super finishing	Taper sectioning and microscope, Interferometer microscope	

a) The true plan of design may be flat, circular, spherical or any contour, such as on cams, gear teeth, etc.

Similar conditions also exist on less accurate bearing surfaces in local areas of contact or when surface asperities collide and plow through the contaminate on the surface into clean metal.

Molecular adhesion has become one of the least disputed ingredients in the collective term of friction. It is the most destructive. Friction and wear damages increase with the size of the welded junctions between mating surfaces.

How to describe a surface

An attempt is made in Table 2 to list the terms and definitions which are being used to describe the conditions of bearing surfaces and the measuring tools in use.

Fig 1 shows how waviness of a ground surface becomes visual at the beginning of a superfinish operation.

Fig 2, at the left, illustrates a cross-directional finish pattern intentionally produced by superfinishing. At the right is a mirror finish also produced by superfinishing which essentially has no directional pattern.

Surface waviness

Fig 3 shows surface waviness on a circular plane.

Fig 4 shows surface waviness on a true flat plane.

Waviness reduces the number of possible contacts which usually start with 3 as load is being applied.

In the process of wearing down a small number of high points to an area sufficiently large to carry the load, protecting surface oxides are removed quickly. The yield strength of the metals is invariably exceeded even at light loads, the number of welded junctions are small but areas are large. The wear debris is correspondingly large or galling is severe.

There is nothing good to be said about waviness unintentionally produced by machining.

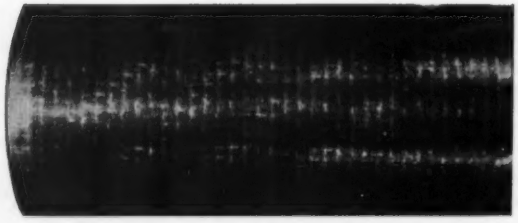


Fig 1. Waviness of a ground surface becomes visual at the beginning of a superfinish operation (by courtesy of Gisholt Machine Co, Madison, Wisc., USA).

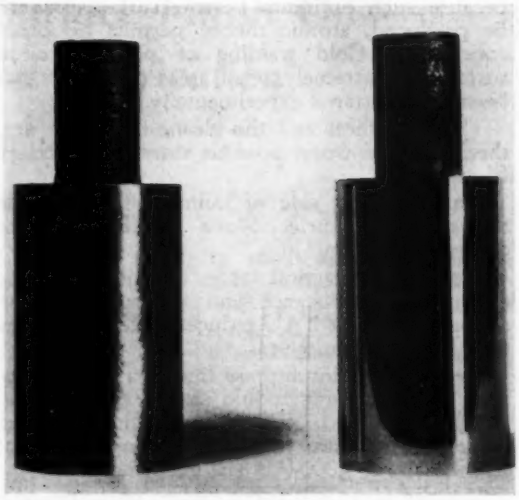


Fig 2. The left illustration shows a cross-directional finish pattern intentionally produced by the method of superfinishing which essentially has no directional pattern.

Less damage would be expected if the peaks of all surface waves were in the same plane, increasing thereby the number of possible initial contacts. This condition is being approached practically on lathe beds where waviness left by machining is being reduced by hand scraping leaving a substantially large number of small scraper waves, the peaks of which are substantially in the same plane.

In a series of tests with surface finishes in the 1-10 microinch rms range produced by various methods of finishing, the best results were obtained with a specimen ring lapped to the highest standard of trueness and geometrical accuracy (least amount of waviness), subsequently roughened by sandpapering.[7]

Waviness is the most undesirable and destructive type of surface irregularity and it is rather fortunate that most of the methods developed for reducing surface roughness have also brought about a reduction in surface waviness. There is reason to suspect that some of the improvements in friction wear and lubrication now attributed to reductions in surface roughness are in fact due to a reduction in surface waviness.

Measuring surface roughness

There are two optical instruments which permit the measurement of surface roughness.

One originally developed by G. Schmaltz in Germany is known as the optical cut microscope or as the 45° light section microscope. A thin beam of light is thrown on the surface at an angle

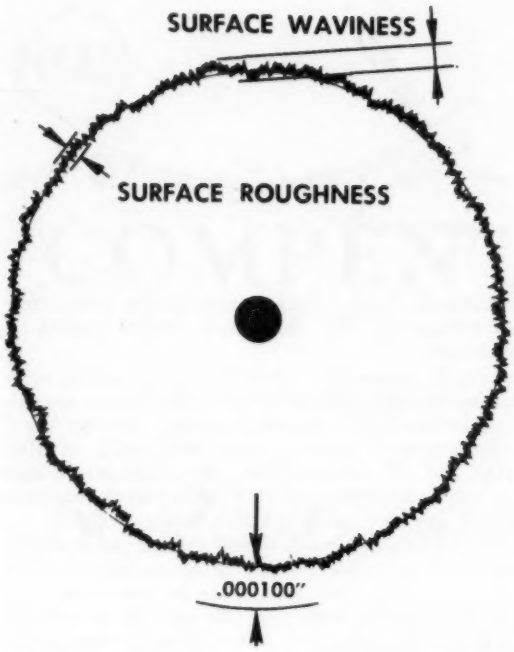


Fig 3. Surface waviness of a circular plane (actural trace of highly finished race of a roller bearing).

of 45° reflecting the surface profile into a microscope on the opposite side at a 45° angle.

The other, known as the blade edge microscope or 60° microscope, works quite similarly. For a sharper definition of surface profile, a sharp blade edge intersects the beam of light on the surface.

One limitation of these instruments is that only very small sections of a surface are in view.

However, multiple beam interference microscopes have been developed by Johanson which will not only measure depth in the range of 0.04 to 4 microinches, approaching atomic dimensions, but also give some indication of surface profile.[8]

The most popular American instruments used in shops and many laboratories for measuring surface roughness employ a stylus with a diamond tracer point having a radius of 0.0005 in. (0.0127 mm). The tracer point is lightly pressed on the surface and slides across. The motion of the tracer perpendicular to the surface is electrically amplified and the circuits are such that values of microinches rms, or AA or CLA are directly indicated on a dial.

The measured value is related to the average depth between small surface ridges (asperities). There are variations in instrumentation and in the methods of indicating and expressing what is being measured.

In the USA surface roughness is still generally expressed in microinches root mean square (microinches rms), although the American Standards Association (ASA) in 1955 adopted a system in which roughness is expressed as ' the arithmetical average deviation from the mean line in microinches AA.' This is identical with the British Standard, described as microinches centre line average (microinches CLA). In Germany ' roughness depth ' (R) in microns is used. Definitions, variations and other details of the systems may be found in US Standards ASA B46. 1-1955; British Standard Specification No 1134 : 1950 and German Specification DIN 4760, 4761, 4763 and 4764. The Swedish and French systems of expressing roughness deviate again slightly from the rest. Although the value figures expressing roughness by the various systems in use differ, they all rate finishes from smooth to rough in about the same order.

Values expressed in microinches rms are about 11% higher than microinches AA or microinches CLA.

Rms or CLA or AA values are approximately ¼ to 1/3 of actual depth. If all surface asperities were triangular in shape, the AA or CLA values would be 0.25 of the total depth (See Fig 5). For sinusoidal impressions the AA value reaches approximately 1/3 of total depth (See Fig 6). Other practically possible profiles or combinations thereof fall within this range.[9]

Precision reference specimens recommended by the ASA have a profile as shown in Fig 7.

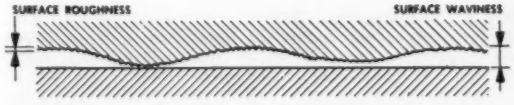
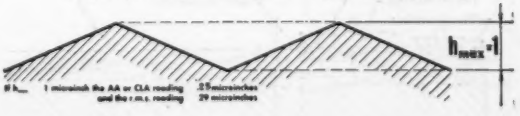


Fig 4 (above). Surface waviness on a flat plane.

Fig 5 (below). Triangular asperity profile.



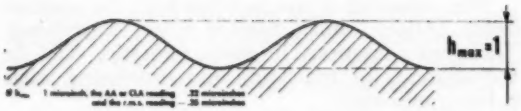


Fig 6 (above). Sine wave profile.

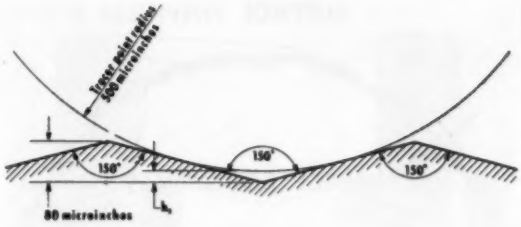


Fig 7 (right). Precision reference specimen, 20 microinch AA or CLA.

A stylus point of 500 microinch radius is superimposed to scale on a 20 microinch (AA or CLA) finish. The error in instrument indication is related to the distance h_1, and for microinches AA, it is 12%. The error increases with finer finishes.

By the use of precision reference specimens and a stylus calibration curve, such errors can be partially compensated for. However, this compensation is based on the profile of the precision reference specimen and is accurate only if it is conceded that the reference profile is representative of the finish being checked. ASA standards state that the effect of stylus radius is less pronounced on machine surfaces than on the precision reference specimen which infers that in practice the included angles average more than 150° or the peak to peak over depth ratio is larger.

In one case of an actual surface profile obtained on a ground finish of 8 microinches rms by the taper sectioning method, 35 slope angles of adjoining asperities were actually measured and averaged to an included angle of 128°.[10]

D. E. Williamson[11] and R. E. Reason[12] found extremely small differences in roughness indications with tracer point instruments for tip radius variations in the range of 100 to 500 microinches, amounting to less than 10% on a 6 microinch finish. Both conclude that with a few exceptions a 500 microinch stylus radius is adequate.

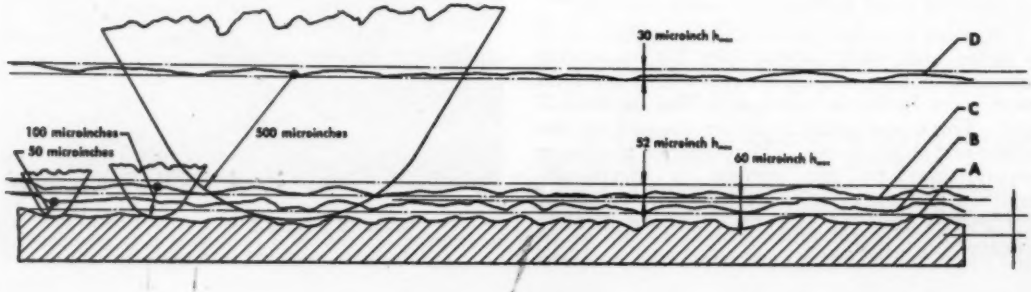
Fig 8 shows the effect of tracer points with different radii, especially with reference to recording surface profile on graph paper. Stewart Way[9] superimposed tracer points with radii of 500, 100 and 50 microinches on photographically enlarged, accurate surface profile curves made by C. B. Sawyer[13] using the sectioning method.

The distortion of the true surface profile with the 500 microinch point is quite large; so is the previously discussed error in measuring true depth. Traces with the 100 and 50 microinch points by comparison come close to the actual surface profile. While increased vertical magnification usually employed in recording instruments is of considerable aid in the study of fine contour detail, it cannot correct for the distortion which originates with finite tracer points.

The 500 microinch tracer point certainly appears adequate for surface finishes rougher than 20 microinches AA. It may also be sufficiently adequate for quality control of manufacturing of finishes finer than 20 microinches. However, its adequacy is in serious doubt for research on surface finish.

The selection of the stylus radius of 500 microinches for standard instruments is a compromise between desirable ruggedness of the instrument, accuracy, and the effect of scratching the surface. Even so, scratching will occur on the softer nonferrous materials[14] and the method cannot be

Fig 8. Magnification 2000 ×. A = True profile, B = Trace using point radius 50 micro-inches, C = Trace using point radius 100 micro-inches, D = Trace using point radius 500 micro-inches.



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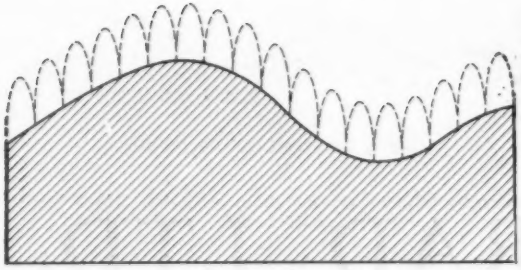


Fig 9 (above). Illustrates the 'jumping' of the tracer point from one measuring spot to another.

Fig 10 (below). Forster trace of 10 microinches rms finish.

used at all on conversion coatings such as iron-manganese phosphating.

A number of sliding tracer point instruments of the indicating and recording type with point radii down to 100 microinches are commercially available.

The 'Forster' instrument features a jumping tracer point in which sliding contact is reduced to a minimum. The smallest tracer point has a radius of 100 microinches. It jumps across the surface in 40 microinches intervals (See Fig 9) thereby reducing straining and wear on the point. A recording camera produces the profile trace (Fig 10).

Taper sectioning

Taper sectioning will show details of the profile structure of surface roughness ridges more accurately than can be revealed by other methods. It can be used on flat as well as on cylindrical surfaces. Its main disadvantages are that it destroys the specimen and compared with tracer point methods, it is time consuming and expensive.

Fig 11 illustrates the method on a flat surface. A cut is made at an angle through the ridges which magnifies the true height of the ridge profile. An angle of 2° 17′ with a resulting magnification of 25 has been quite frequently used.

The profile section cut is then finely ground and metallographically polished.

Since every step in finishing the surface will distort the edges of the minute profile contour by burring or smearing over, the surface must be backed up or supported with a strongly adherent coating about the same hardness as the profile

Fig 11. Method of taper sectioning a flat surface.

Fig 12. A 90° cross section of a ground steel surface, 8 micro-inches rms finish, magnification 500 ×. While it shows some deviations from a true plane, the large number of fine surface ridges do not show because the limits of optical resolution of the microscope is in about the range of depth of these finer ridges[15].

Fig 13. Taper section of surface from Fig 12. Vertical magnification 12500 × ; horizontal magnification 500 × ; (enlarged 5 × from original 2500 × vertical and 100 × horizontal[15]*).*

section. For steel surfaces, nickel plating has been preferred. To increase colour contrast between steel and nickel for photographic purposes, blacking of the steel by heating has been used successfully.

A photomicrograph is then taken of the profile. For a microscope magnification of 100x the vertical magnification is 2500x. Figs 12, 13, 14 and 15 illustrate the result of this method. Ref 15, 16, and 17.

The significance of surface roughness

The significance of surface roughness is still the subject of some controversy.

Fig 14. Worn-in taper section from Fig 12 vertical magnification 12500 ×; horizontal magnification 500 × (enlarged 5 × from original 2500 × vertical and 100 × horizontal). This section was made after the surface (a shaft) was worn-in under load for 6 hours using SAE30 motor oil for lubrication. The flattened asperities can be clearly seen when compared with Fig 13 which is representative of the original new surface[15].

The following two apparently controversial reports, dating back to 1940, still sound current today.

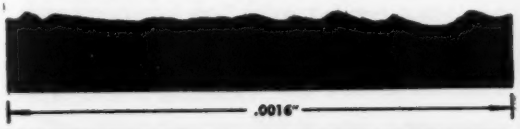
'It has long been known that roughened operating surfaces will often give much better service than ultra-smooth ones. Lubrication is better maintained in the region of boundary lubrication. One manufacturer first puts a 5 microinch surface on certain parts and then purposely roughens them with a honing process. This method puts depressions in smooth areas with no high peaks.'[18]

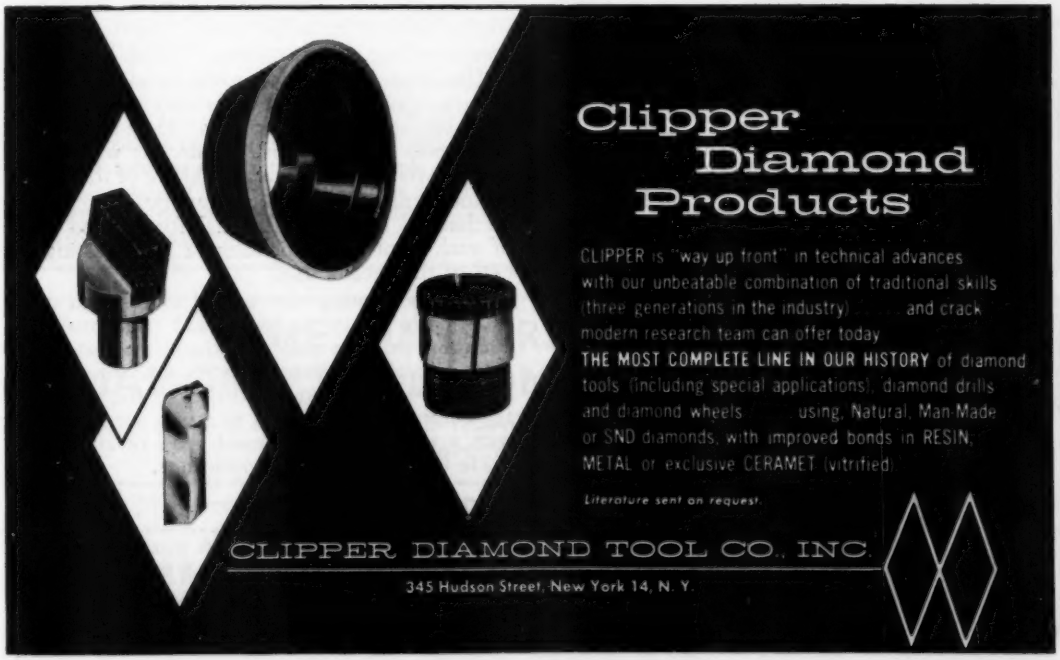
D. A. Wallace[19] reported a three-fold increase in load carrying capacity for superfinished specimens approx 2 microinches rms over the rougher ground specimens 22 to 28 microinches rms on the SAE oil testing machine.

Fig 15. Section of Fig 15 accurately redrawn to cancel out the 25 × vertical distortion. This now represents the contour of the true surface 8 microinches rms; magnification 2000 ×.

In the light of current knowledge and experience, however, these statements are less controversial considering that Arthur F. Underwood[18] directly refers to boundary lubrication and in tests by Wallace[19] hydrodynamic lubrication was predominant.

Many tests on surface roughness are made with mating metal combinations which are most commonly used in the largest number of practical applications. These are medium hard steel on comparatively soft copper alloys or babbit and show a decrease in load carrying capacity with increasing roughness of the harder mate. It is what one would normally expect and holds for this particular combination of mating materials and for the asperity profile structure peculiar to the method of finishing.

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About 15 years ago surface finishes in the overall range of 2 to 25 microinches rms (finer than heretofore used) were introduced on a rather large scale in the automotive industry. Bad field experience with these finer finishes soon resulted in a reversal. The same variety of parts are now made in a roughness range of 4 to 60 microinches rms.[20] The main reasons given were difficulties with the finer finishes to 'wear-in' properly, with more frequent scuffing as a result. On the automotive parts in question, a combination of hydrodynamic and boundary friction exists.

One interesting observation on brake drum finishes was that they 'wear-in' quickly to a finish of 15 to 20 microinches rms whether they begin with a finer or a rougher machined surface.

The results of a series of tests made at The Alpha-Molykote Corporation with ground finishes in the range of 10 to 70 microinches rms and sandblasted finishes in about the same roughness range may furnish a base for further study.

The tests were a part in a programme of developing bonded solid film lubricants and a short review of background appears useful.

The main constituents in bonded solid film lubricants usually are: a solid lubricant of fine particle size, such as graphite or molybdenum disulphide and a resin binder dispersed in a volatile solvent. The resin can be thermoplastic which hardens in air at room temperature or a thermosetting resin requiring baking.

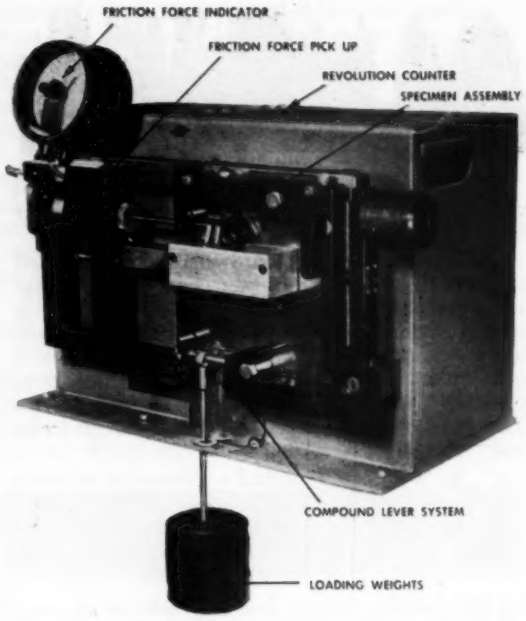

Fig 17. LFW-1 testing machine.

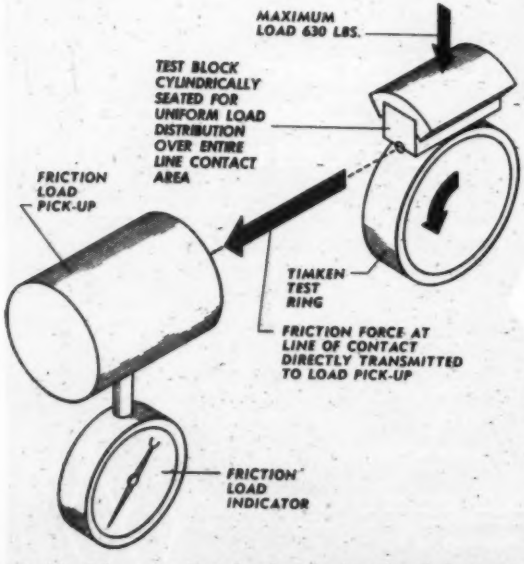
MAXIMUM LOAD 630 LBS.
TEST BLOCK CYLINDRICALLY SEATED FOR UNIFORM LOAD DISTRIBUTION OVER ENTIRE LINE CONTACT AREA
FRICTION LOAD PICK-UP
TIMKEN TEST RING
FRICTION FORCE AT LINE OF CONTACT DIRECTLY TRANSMITTED TO LOAD PICK-UP
FRICTION LOAD INDICATOR

Fig 16. Schematic view showing the functional characteristics of the Model LFW-1 testing machine.

The resin bonds the solid lubricant to the surface. Such lubricant films may be applied by brushing, spraying or dipping. They have found their most extensive use in aircraft where they usually serve for the operational life of the parts.

Roughening of the surfaces by chemical or mechanical means is essential for a good bond of such films. Phosphating or sandblasting are two of the means used.

For sandblasting, the use of aluminium oxide 120 mesh (sieve opening 125 microns) was common practice and was made mandatory by many aircraft specifications. Since no information could be secured on the origin of the choice of 120 mesh, it was decided to run a series of tests with a variety of other mesh sizes of aluminium oxide to determine its significance.

Experiments

The type of test used is a modified Timken test, which has been employed in the USA for checking the wear life of bonded solid film lubricants for many years. The specimen assembly, the type of loading and friction

Table 3—Test specimen data

	Test Block	Test Ring
Material	Chrome Moly Steel SAE 4130 (C 0.3, Mn 0.5, Cr 0.95, Mo 0.2)	Nickel Moly Steel SAE 4620 (C 0.2, Mn 0.55, Ni 1.8, Mo 0.25) Figure 17 LFW-1 Testing Machine
Size	0.205″ wide, 0.400″ high, 0.620t long	1.377″ dia, 0.344″ wide average indicator run out on O.D. when mounted 0.002″
Hardness	27-33 Rockwell C	60 to 63 Rockwell C case hardened, case depth 0.025″ to 0.030″
Ground Finish (Surface Roughness) In Direction of Sliding Motion	4-5 microinches rms	8-12 microinches rms[1]
Ground Finish (Surface Roughness) Across Direction of Sliding Motion	5-6 microinches rms	8-12 microinches rms[1]
Sliding Velocity	Stationary	26 feet per min (72 rpm)
Maximum Load	630 lbs	
Maximum Average Static Hertz Pressure	109000 PSI static (neglecting motion and influence of lubricant coating on test ring)	

1) Sandblasting was applied to this finish.

measuring systems are shown in Fig 16.

Fig 17 is a general view.

Table 3 gives essential details.

Fig 18 shows the loading schedule used in the wear-in procedure.

Preparation of specimen

The rectangular test blocks with a fine ground finish of 4 to 6 microinches rms received no other surface treatments. They were cleaned by washing in benzine followed by an alcohol rinse.

TRADE NAMES INDEX 1960

Subscribers to *Industrial Diamond Review* will already be aware that the above publication is due to appear within the next couple of months. Owing to the heavy demand already evident, those wishing to obtain copies are requested to order them as soon as possible. Publication price has not yet been decided and money should not, therefore, be enclosed with orders. The price is not likely to exceed 5/-.

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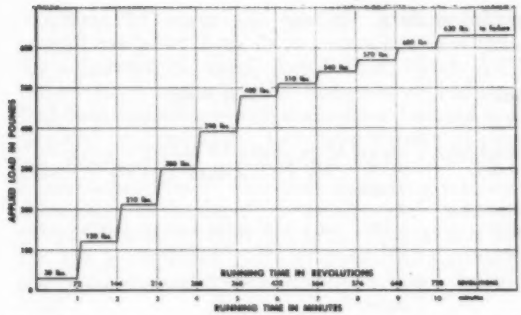

Fig 18. Loading schedule used in the 'wear-in' procedure.

The test rings were prepared as shown in Fig 19.

The sandblasting was done as shown in Fig 20 and the method of spraying is shown in Fig 21.

The wear life data of about 7,000 machine hours of testing is presented in Fig 22. The criterion for wear life is the coefficient of friction indicated by the machine. The electrical contact pointer in this test series was set for a coefficient of friction of 0.1. When this is reached, the machine shuts off automatically recording revolutions to failure on a counter.

The criterion of = 0.1 is arbitrary but reasonable. The process of final breakdown of these coatings is quite rapid. A typical friction curve Fig 23 indicates this.

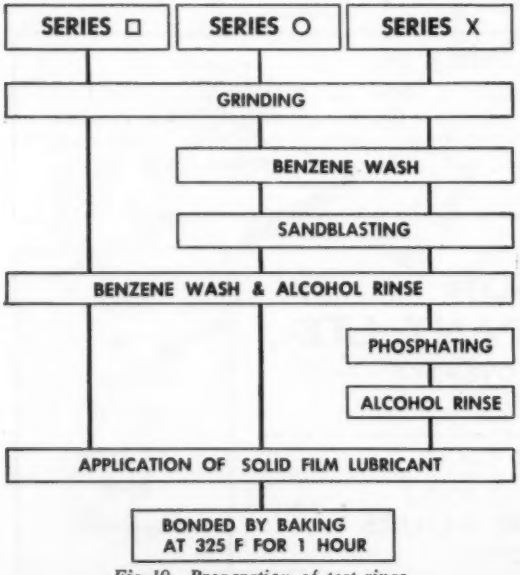

Fig 19. Preparation of test rings.

The aluminium oxide of the various mesh sizes used were commercial grades and in view of the extreme sensitivity of wear life on the particle size of the blasting media, sieve analyses were made. Fig 24 shows the distribution for the 200 mesh commercial grade before use.

Discussion of results

On a subject as complex as boundary friction, wear and lubrication, the safest first reaction is, that these results are characteristic of and limited to bonded solid film lubricants. Even for this limitation, they are only applicable to all the conditions of this test, such as bearing metal

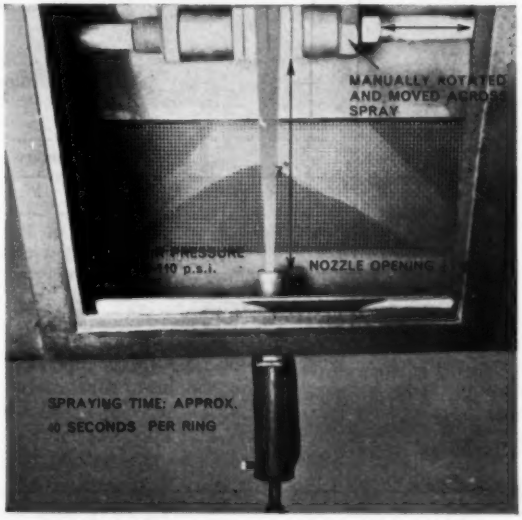

Fig 20. Method used for sandblasting test rings.

combination, type of contact, loads and sliding velocity used.

Within this limited scope, then, the wear life of solid film bonded lubricants applied to surface finishes within the 10 to 15 microinch rms range is from 2 to 20 times better on sandblasted surfaces. The improvement factor of 20 is reached at 20 microinches rms for the sandblasted surface. Wear life drops off steeply for coarser, and for finer finishes.

It is questionable that the results obtained represent a possible optimum for sandblasted surfaces unless the unintended particle size distribution of the commercial grades of Al_2O_3 or their particle shape (see Table 4) is the best.

Can this difference of 2000% in wear life between two surfaces of equal tracer point roughness, one ground and the other sandblasted, be entirely attributed to the better bond of the resin on a sandblasted surface? Of course, a

Table 4

Sieve analyses of commercial grade Aluminium Oxide, 200 mesh

Sieve Mesh Size	Sieve Opening in microns	Al_2O_3 in %
120	125	0
120-140	125-105	5
140-170	105-88	21
170-200	88-74	19
200-230	74-62	18
Finer than 230	62	37

work hardening effect may partially contribute towards better results but the magnitude of improvement from this source would be small.

If the solid bonded film lubricant completely separated the surfaces up to the point of failure, the assumption that the better bond was the main cause might hold. Fig 24 shows the wear ratios of the lubricant coating. Although the magnetic type thickness gauge used indicates a coating thickness on the order of 0.0004 in. after 150,000 revolutions, metal to metal contact of surface asperities seems to have actually started even before the full load is applied during the first 3 minutes of a test (See Fig 25).

In support of some other contributing cause are tests reported by O. R. Schurig[21] on the Almen film strength testing machine using oil as the lubricant. Sandblasted finishes (60 microinches rms) steel on steel supported 3 times higher loads to failure than finer ground finishes (18 microinches rms).

On the geometry of surface roughness

The asperity structure of a ground finish is basically one of ridges and sandblasted surfaces have a pyramidal structure.

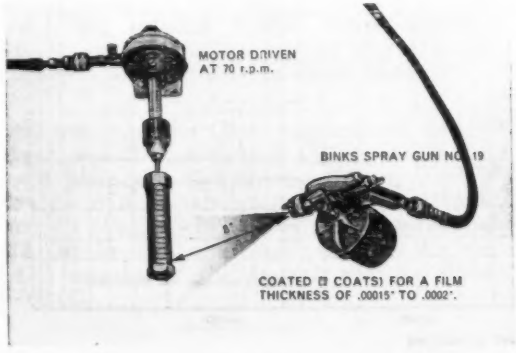

Fig 21. Method used for coating test rings.

Assume mating asperities A (Fig 26) to be ridges, sliding upon one another perpendicular to the plane of the paper. Contact would continue over the length of the ridge. A cold weld which may form is long and strong in the direction of sliding and damage due to galling or wear debris is correspondingly high. If ridges of one mating surface cross ridges of another, contact will also be maintained for the length of one ridge. In contrast, A being a pyramid, contact for any direction of sliding motion is shorter. There is a lesser opportunity, therefore, to remove surface oxides or lubricants adhering to the small flat top

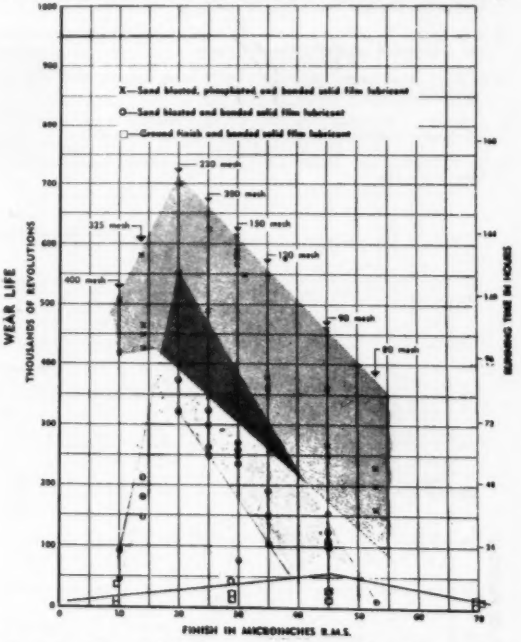

Fig 22. Wear Life versus Surface Finish. Curves show the significance of surface finish and the methods used to produce it.

of the pyramid. The load is supported by a large number of small areas. Welded junctions are therefore smaller, wear debris is smaller in size, and contact with the lubricant in the capillary system is more quickly re-established.

The shape of wear debris developing with a ridge structure may range up to long slivers and curled up wire edges initiating added damage, whereas the debris emanating from the top of a pyramidal structure is smaller than adjacent valleys of the surface.

In a pyramidal asperity structure, the valleys are all inter-communicating, forming a more efficient capillary system for the lubricants.

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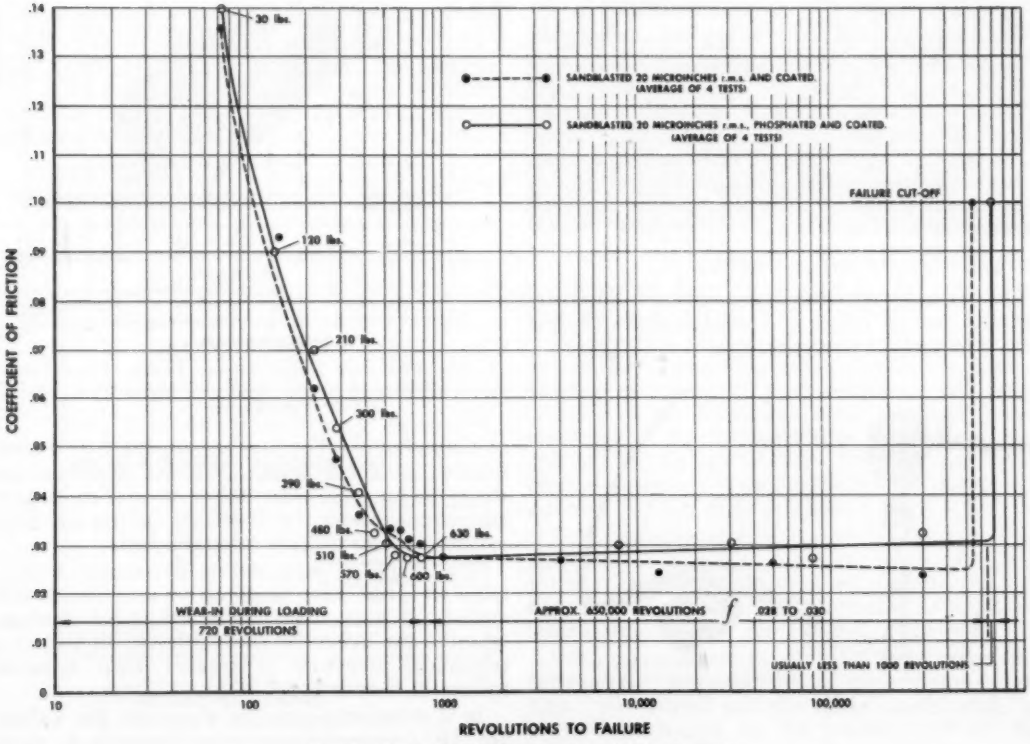
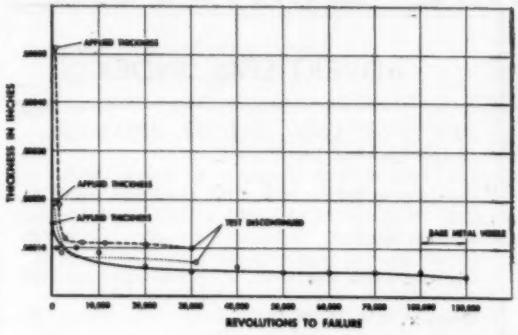


Fig 23. Typical ' friction force to failure ' curve.



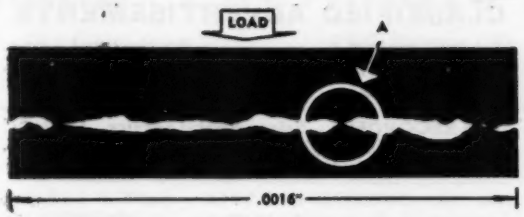


Fig 24. Wear rate of lubricant coating applied to 20 microinches rms sandblasted finish of test ring.

Fig 25. Wear scar development on test block (Lubricant coating on test ring applied to 20 microinches rms sandblasted finish).

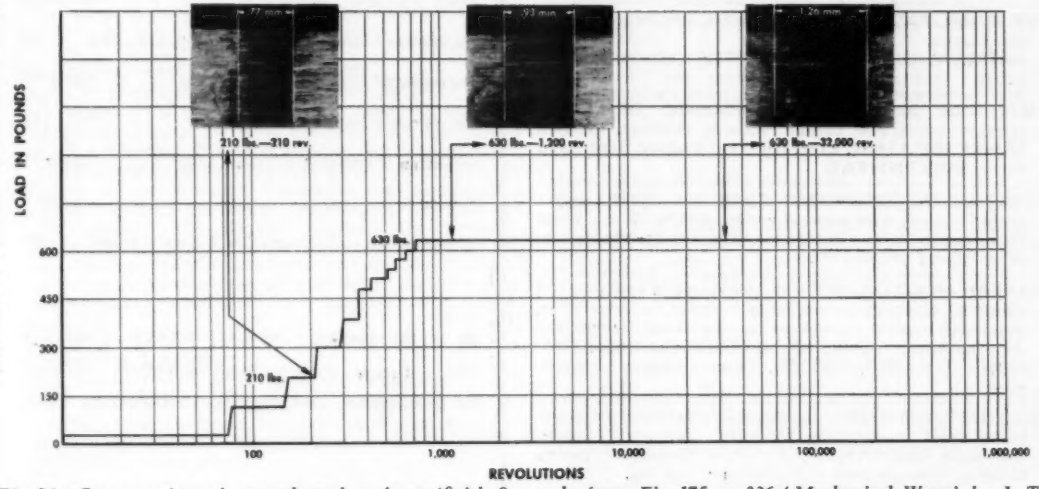


Fig 26. Cross section of ground steel surfaces (finish 8 microinches rms). Magnification 2000 × (redrawn to scale from Fig 175, p 336 'Mechanical Wear' by J. T. Burwell Jr, American Society for Metals, 1950).

News in Brief

British Guiana's diamond production in February 1960 totalled 40,291 stones weighing 6,465,35 metric carats, as against 28,595 stones weighing 5,205,35 metric carats in January.

According to the Chief Inspector of Mines, Sierra Leone, more than 79,000 carats of diamonds were exported during February, 1960. The value of diamonds bought under the Alluvial Diamond Mining Scheme for that month totalled £743,000, bringing the total purchases for the first 2 months of the current year to about £1,400,000.

It was reported from Swaziland that intensive underground prospecting is taking place at Bomvu Ridge, where the Swaziland Iron Ore Development Company is investigating iron deposits. Diamond drilling from the surface is also being undertaken.

According to the South African Department of Customs and Excise, exports of diamonds during the first quarter of 1960 totalled £8,350,422, as compared to £12,427,684 during the corresponding period last year.

Summing up Israel's industrial achievement in the 11 years ending in 1959, the Minister of Commerce and Industry, Pinhas Sapir, stated that industrial exports, including diamonds, had risen 11½ times.

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INDUSTRIAL DIAMOND ABSTRACTS

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1960 Volume 17
MAY

DIAMOND MINING AND INDUSTRY

£91,135,943 worth of diamonds sold in past year—De Beers establishes three new records

Anon. *Diamond News* 1960 Vol 23 (4) pp 6-7 (Jan)

Tables give figures released by De Beers Consolidated Mines Ltd showing diamond sales through the Central Selling Organisation on behalf of South African and other producers for the fourth quarter of 1959. Gemstones are distinguished from industrials but total diamond sales are also given. Quarterly figures for 1957 and 1958 are compared with 1959 figures, and a special table indicates the trend of sales from 1944 to 1959. *D* *F.251*

The ' pork-knockers ' of British Guiana

Anon. *Gemmologist* 1960 Vol 29 (343) pp 30-36 (Feb)

A summary of the official report ' Diamond resources of British Guiana ' by E. P. Pollard, C. G. Dixon, and R. A. Dujardin. Diamond deposits in British Guiana are mostly worked by individual prospectors. The main source is the Roraima Formation and considerable alluvial deposits are found within about 15 miles of this plateau. The diggers' methods are discussed, although the writers conclude that the days of the individual prospectors are numbered and that the main potential of the diamond industry lies in the large scale mechanized exploitation of the terrace deposits. 1 illustr. *K* *F.13.3474*

[Birmingham Exhibition]

Anon. *Min J* 1960 Vol 254 (6494) p 159 (Feb 5)

An exhibition of industrial diamonds, organized by the Industrial Diamond Information Bureau, was held in Birmingham in February-March, 1960. A number of lectures was given. *D* *Fc.27*

Rich mineral resources spur Communist China's bid for industrial power

K. P. Wang. *Miner Tr Notes (Supplement No 59)* 1960 Vol 50 (3) 35 pp (Mar)

A table illustrating Communist China's present status of self-sufficiency for certain mineral products shows that estimated 1958 output of industrial diamonds was small, and that probable output in 1962 will be moderate. 11 illustr.
D *Bc.12.372/Fc.12.372*

Mining miscellany

Anon. *Min J* 1960 Vol 254 (6493) p 136 (Jan 29)

The diamond fields of the Yakutalmaz Trust, in Eastern Siberia, are said to have increased diamond output more than two and a half times in 1959 compared with 1958 production. A 30% increase is expected this year. The first Soviet floating diamond dredge will be put into service shortly at Mirny, the centre of the Soviet diamond industry.
D *F.13.332*

Solving the materials problem by substitution

J. J. Schanz. *Miner Ind, St Coll Pa* 1960 Vol 29 (5) pp 7-8 (Feb)

Types and reasons for substitution are discussed and a table lists mineral commodities with appropriate substitutes : synthetic diamond and silicon carbide are given as alternatives to diamond. 1 table.
D *F*Fh*Rgc*

More about Arkansas diamonds

Anon. *' Mindrill ' Bits & Pieces* 1960 Vol 12 (9) p 3 (Jan)

A 3.65 ct diamond found in the ' Crater of Diamonds ' in Arkansas has been named after Governor Orval Faubus. Arkansas industrial diamonds are reputedly 228% harder than any others.
D *F.12.342*

Diamond activities in Brazil

Anon. *' Mindrill ' Bits & Pieces* 1960 Vol 12 (9) p 3 (Jan)

In Maraba, Para, mining operations on the Tocantins River were more active during the first half of 1958. A new firm, reportedly a joint American-Brazilian undertaking, was mining the Jau Canal, which has the richest diamond deposits in that region. Modern techniques and equipment were being used.
X *F Hd.346*

Where natives sell diamonds in streets

Anon. *Diamond News* 1960 Vol 23 (4) p 7 (Jan)

It is reported that diamonds are being touted almost openly in the main street of Maseru, capital of Basutoland. This illicit trade is causing concern and would cause more except that much of it is not in real stones. *D* *F.251.2598.361*

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Physical, Chemical, and Mechanical Properties of Diamond	A122	Wire Drawing	A130
Physical, Chemical, and Mechanical Properties of Hard Materials	A122	Grinding and Polishing of Carbides and Metals	A130
Diamond, etc, in Instruments	A122	Machining Developments	A133
Hardness and Wear Testing	A123	Production, Grading and Recovery of Abrasive Particles	A134
Truing of Grinding Wheels	A124	Tool Production...	A134
Precision Machining of Metals	A126	Powder Metallurgy	A136
Cutting and Machining of Stone, Glass, etc ...	A128	Miscellaneous	A137
Gem Polishing	A129	Book Reviews	A137
		Patent Lists	A137

Alluvial diamond returns for October, November and December 1959

Anon. *Diamond News* 1960 Vol 23 (4) pp 31-32 (Jan); (5) pp 33-34 (Feb)

Rough and uncut diamond production in October 1959 for Cape Province: 6,972.75 ct of total value £62,234 (181s 4d per ct); Private Estates: 239.25 ct of total value £3,397 (283s 11d per ct); Transvaal Province: 12,746.50 ct of total value £46,900 (73s 7d per ct). Thus, total production amounted to: 19,958.50 ct of total value £112,531 (111s 11d per ct).

Rough and uncut diamond production in November 1959 for Cape Province: 4,456.25 ct of total value £38,584 (173s 2s per ct); Private Estates: 216.50 ct of total value £2,884 (266s 1d per ct); Transvaal Province: 13,765.00 ct of total value £43,908 (63s 9d per ct). Thus, total production amounted to: 18,437.75 ct of total value £85,376 (92s 7d per ct).

Rough and uncut diamond production in December 1959 for Cape Province: 4,668.75 ct of total value £39,009 (167s 1d per ct); Private Estates: 178.25 ct of total value £1,769 (198s 3d per ct). Thus, total production amounted to: 4,847.00 ct of total value £40,778 (168s 3d per ct).

M *Ebe F.13.361*

PHYSICAL, CHEMICAL, & MECHANICAL PROPERTIES OF DIAMOND

New electron radiation facility at Diamond Research Laboratory

J. F. H. Custers. *S Afr Min & Engng J* 1960 Vol 71 Pt 1 (3493) pp 426-427, 429 (Feb 19)

The new Philips high voltage electron accelerator, installed early in 1960 at the Diamond Research Laboratory, will be used primarily for studying the effects of both electrons and gamma rays on diamonds and other solids, particularly metals. It is expected that the electrons will alter the surface structure and texture of diamonds, resulting in new etching phenomena and surface changes. The generator will be used to affect the electrical properties of semi-conducting diamond crystals and the effects of electrons and gamma rays on diamond colour will be studied; it is possible that other properties of the diamond crystal may be changed as well. The accelerator is housed in a pressurized tank. Its main parts are described under five headings: the cascade high voltage generator, the accelerator tube, vacuum equipment, control system, and gas pressure system. 1 illustr.

See also *Industr Diam Rev* 1960 Vol 20 (231) p 39 (Feb). *D* *F Ul V W*

Identifying precious stones (XIV). Wir bestimmen Edelsteine (XIV)

Anon. *Gold u Silber* 1960 Vol 13 (3) pp 24-25 (Mar) (In German)

Directions are given for determining whether a stone is singly or doubly refractive. Diamond belongs to a small group of precious stones which are singly refractive, but anomalous double refraction may be caused by inclusions of foreign matter which create internal stress within the stone. An instrument known as the Polariskope, specially designed for determining the single or double refraction of stones, is described. 4 illustr. *K* *Bb Cz/F Ukk V Wcdz*

PHYSICAL, CHEMICAL, & MECHANICAL PROPERTIES OF HARD MATERIALS

Equilibrium and growth forms of crystals. Gleichtgewichts- und Wachstumsformen von Kristallen

B. Honigmann. *Metalloberflaeche* 1960 Vol 14 (3) p 80 (Mar) (In German)

Book, Vol 4, Series 'Progress in physical chemistry'. Dr. Dietrich Steinkopff, Darmstadt. 1958, 161 pp, illustr. Price DM 26.--.

This volume studies the problems of crystal growth, the technical importance of which has been increasing during the past few years. The author extends the links between equilibrium and growth forms of crystals to actual examples of crystal growth.

[Not in library of Industrial Diamond Information Bureau]. *K* *Bd Ub*

Absolute intensity measurements of the carbon and aluminium X-ray K-lines with a proportional counter

R. M. Dolby. *Brit J appl Phys* 1960 Vol 11 (2) pp 64-66 (Feb)

3 illustr, 8 ref. *D* *Uklb.21*

Tube Investments Research Laboratories

Tube Investments Ltd, Birmingham. *Metallurgia* 1959 Vol 60 (360) pp 147-150 (Oct)

Research includes study of mechanical properties of non-metallic 'whisker' crystals; influence of impurities on metal deformation; lubrication and wear in metal drawing. 5 illustr. *D* *Bd U.21*

Properties and machining of alloys of the Alniko type

Ja. M. Dovgalevskij. J. I. Sokolovskij. *Izv Akad nauk SSSR, Otd techn nauk Metallurg i Topl* 1959 Vol 4 pp 99-105; *Inhaltsverzeichnisse sowjet Fachzeits* 1960 Vol 9 (1) p 76 (Jan) (Original in Russian)

Reports on experiments made on the properties and machinability of various alloys. A new kind of alloy is recommended, whose magnetic properties differ only slightly from the alloy ANK 03, but which offers a greater mechanical strength and improved grindability. *K* *Bfx Ceq/Bfx U*

DIAMOND, ETC, IN INSTRUMENTS

A puff of precision

Sperry Gyroscope Co, Brentford, Middx. *New Scientist* 1960 Vol 7 (175) p 728 (Mar 24)

Time needed for manufacturing an electro-hydraulic servo valve is said to be cut 60% by using a pneumatic gauge to detect when metal removal is sufficient. Four lands have to be ground to a fine tolerance for accurate mating in the finished product of the spool shoulders with cylinder liner ports. A shoe with four holes in the face is placed over each shoulder in the grinding machine. Each hole is supplied with compressed air and when the right amount of metal has been removed from a shoulder, the air escapes from the covering hole, the air pressure drops, and the drop is registered on a dial to show the state of the grind. The four gauges are calibrated to show ten-thousandths of an inch, and tolerances as little as 0.0002 in. are being obtained regularly in the lands by using this device, it is claimed. 1 illustr. *D* *Ag Ceq V Wb*

Crystal studies

Seton Creaghe Engng Ltd, Park Royal, London. *Metal Ind, Lond* 1960 Vol 96 (13) p 250 (Mar 25)

A new multiplane diffractometer for fully automatic or manual operation incorporates goniometric and scanning movements. This X-ray instrument uses the Schulz method of determining the preferred orientation of crystals, which allows the intensities of reflexions to be related without corection to the number of crystals reflecting. Thus it can be used to examine the crystal structure of a specimen in any plane by adjustment of the goniometer ring; setting up the instrument is described. 1 illustr.

D *Bd Wce.21*

About new Zeiss instruments from Jena at the 1960 Technical Fair in Leipzig

R. Jobst. *Jena Rev* 1960 Special issue pp 35-40

16 illustr. *D* *Wc.27.322*

Gratings applied to automatic correction

C. Timms. *Metalworking Prod* 1960 Vol 104 (12) pp 525-527 (Mar)

Extract of paper presented to Institution of Production Engineers.

Covers experimental work done in applying diffraction gratings not only to the measeurment of machine errors but also to their automatic correction. 7 illustr.

D *Tfd V.2591*

The Spectromat as an instrument for measuring colours. Der Spectromat als Farbmessgeraet

E. Rohner. *Schweiz Arch angew Wiss* 1960 Vol 26 (2) pp 60-66 (Feb) (In German)

19 illustr, 3 ref. *K* *Ukb V W*

Swiss P 340,783 (June 27, 1958) **F. Straumann-Schmidlin, K. Karpf, Institut Dr Ing Straumann AG**

Method of making a bearing for spindles in watches and measuring instruments. Verfahren zur Herstellung eines Lagers fuer Wellen in Uhren und Messinstrumenten

The bearing is of steel made from a ferrous alloy containing 20-40% Co, 15-20% W, 0.2-0.5% Mn and 0.1 to 0.4% silicon. The alloy in the form of a wire of 3 mm diameter is homogenized for 5 hr at 885° C, allowed to cool slowly, rapidly heated to 1230° C, and subsequently quenched in a lead bath to 600° centigrade. A cylindrical blank is then cut from the wire and a bearing recess machined and polished. A further annealing treatment may follow in the temperature range 425 to 625° centigrade. The bearing has a Rockwell hardness of 71 (Vickers hardness of 1020 kg/mm^2). Tests have shown that the coefficient of friction of such bearings remains much more stable than that of jewel bearings. The spindle points show less wear than when running in jewels. (13 claims, 2 illustr). *D* *Ay Bfxf Ck.545*

DIAMOND TECHNOLOGY

First published 1942 as "Production Methods for Diamond and Gemstone." The second edition of this book by P. Grodzinski has been revised throughout and considerably enlarged. 840 pages, 486 illustrations, 94 tables, and indexes. From NAG Press Ltd., 226 Latymer Court, London W 6. 54s 6d, post free.

HARDNESS AND WEAR TESTING

Hardness, abrasion, and wear resistance testing of plastics

L. Boor. *Bull Amer Soc Test Mat* 1960 (244) pp 43-47 (Feb)

Hardness testing in general is discussed and particular applications with reference to plastics are described. A method was developed for measuring Rockwell indentations under major load, which is called the Rockwell alpha scale. As well as indentation, scratch hardness methods are summarized and the relationship of the concepts of hardness, abrasion and wear is considered. 5 illustr, 18 ref.

D *Bp Cv|Bp Cw*

Handbook of non-destructive testing. Handbuch der zerstoerungsfreien Materialpruefung

E. A. W. Mueller. *Feingeraetetechnik* 1960 Vol 9 (3) p 137 (In German)

Book, Verlag R. Oldenbourg, Munich. 1959, loose-leaf folder, illustr. Price DM 54.--.

[Not in library of Industrial Diamond Information Bureau]. *K* *Cy.523*

The nondestructive testing engineer — today's career opportunity — the 1959 Lester Honor lecture

C. E. Betz. *Non-destr Test* 1960 Vol 18 (1) pp 15-26 (Jan-Feb)

Traces the development of non-destructive testing methods. 28 illustr. *D* *Cy.1456:.132*

Survey of various special tests used to determine elastic, plastic and rupture properties of metals at elevated temperatures

F. Garofalo. ASME Annual Mtg paper 59-A-112; *Mech Engng, NY* 1960 Vol 82 (3) p 102 (Mar)

[Not in library of Industrial Diamond Information Bureau].

E *Bf Unc.1312|Bf Und.1312|Bf Unt.1312*

Roughness of steel end milling. Rugosité de fraisage en bout des aciers

Abbé Cayère. *Mach Mod* 1960 Vol 54 (612) pp 27-32 (Mar) (In French)

14 illustr. *K* *Pdz Rw Unf*

Portable hardness tester. Tragbares Haertepruefgeraet

Anon. *Industr Anzeig* 1960 Vol 82 (26) p 398 (Mar 29) (In German)

Large, heavy machine parts cannot usually be tested on stationary hardness testers. For this reason, portable hardness testers which can be clamped on to the testpiece are now being used. A hydraulic system allows a test load of up to 30 kg to be brought to bear by hand, when diamond indenters are being used. The hardness range is between 150 and 1100 DPH. Diamond pyramids can be exchanged for Brinell steel balls. 1 illustr. *K* *Wgh*

Friction as the main cause of bluntness in tools. Reibung als Hauptursache des Stumpfwerdens von Werkzeugen

Anon. *Technik u Betrieb* 1960 Vol 12 (3) pp 51-53 (Mar) (In German)

11 illustr. *K* *Pd Uqe:Ung*

Motorized Hardness Tester

Torsion Balance Co, Clifton, NJ. *Mod Mach Shop* 1960 Vol 32 (9) pp 206, 208 (Feb)

Known as the Motorized Kentrall Hardness Tester, this machine automatically removes major testing loads and is said to eliminate much of the effect of operator techniques. It is also available as a combination tester, providing both regular and superficial Rockwell hardness testing in a single machine. 1 illustr.

D *Wgh*

New developments—a reflection on the achievements of the workers of the VVB Mechanik. Neuheiten—Spiegel der Leistungen der Werktaetigen der VVB Mechanik

D. Meichsner. *Feinmechanik u Optik* 1960 Vol 77 (3) pp 66-70 (Mar) (In German)

Among the instruments to be shown at the Leipzig Spring Fair is an automatic Rockwell hardness tester, the HRA, which will classify testpieces under the categories, too hard, nominal, and too soft. 10 illustr.

K *Wgh.27.322*

New control and heat treatment department of Holman Group

Holman Group, Camborne, Cornwall. *Metallurgia* 1959 Vol 60 (360) pp 143-144 (Oct)

Hardness and other tests in the inspection section use, among others, Brinell, Rockwell, Vickers and Shore scleroscope hardness testing machines. 4 illustr.

D *Qd Wgh*

Isoma M.104 optical hardness tester

British agents: Matchless Machines Ltd, 18 Bolton St, London W 1. *Metalworking Prod* 1960 Vol 104 (12) p 535 (Mar 23)

Dotted cross-line graticules are incorporated in the eye-piece of this optical hardness tester and aligned with the sides of the diamond impression for measurement. Vernier graduations permit readings to 0.000004 in. and a Vickers hardness number is obtained from a set of conversion tabels supplied. Load on the diamond can be varied from 50 to 1,000 g by an air automatic selector. 1 illustr.

D *Nd Tfj Wgh*

DAS 1,066,364 (Sep 23, 1955) **K. Meyer, Ernst Leitz GmbH**

Method for the optical measuring of surface indentations, in particular of indentations produced by hardness tests. Verfahren zum optischen Ausmessen von Oberflaecheneindruecken, insbesondere der bei der Haertepruefung entstandenen Eindruecke

When determining the size of an indentation, *eg* by optically measuring the length of the diagonal of the projected area of a Vickers indentation, several possible errors are to be taken into account, *ie* in the adjustment of the measuring device by the operator, in the accuracy dependent on the dissolving power of the microscope used, in the illumination, *etc.* These errors are of no practical importance for comparative measurements but they prevent exact comparable absolute measurements being obtained. The method suggested is first to determine mechanically the size of a geometrically equal indentation, *eg* the length of the diagonal, then to determine optically the same dimension. The difference between the two dimensions (measuring error) is used for correcting the dimensions obtained by optically measuring the indentation produced by the test. The method requires that various sizes of geometrically equal indentations are available for comparison. (1 claim).

J *Vs.1456.545*

TRUING OF GRINDING WHEELS

Auto wheelhead truing overcomes problems

F. Kenwood Jones. *Metalworking Prod* 1960 Vol 104 (9) pp 386-388 (Mar 2)

Eight Norton semi-automatic multi-wheel grinders and four Norton CV 4 angular wheel slide grinders finish multiple surfaces on the output- and sun-gear shafts for Ford, USA, automatic transmission. Thirteen diameters and a flange are ground. Compared with single-wheel operations, grinding time is cut 70% and the machines are loaded and unloaded only four times instead of fourteen. Use of multi-wheel grinders has emphasized the importance and possibilities of automatic truing devices built into the head. 5 illustr.

D *Chc Pr Psfz*

Radius dresser is improved

Somerset Tool Co, 320 Virginia St, Hilside, NJ. *Mod Mach Shop* 1960 Vol 32 (9) pp 208, 210 (Feb)

The redesigned Model 'SS' is said to maintain an accuracy of 0.0002 in., has an enlarged capacity and can true all abrasive wheels up to and including 12 in. diameter. Since the wheel is trued from below, the wheel guard need not be removed. Four stop pins allow complete adjustment from 90 to 100°, and the diamond point is easily set by measuring with a micrometer from the top of the measuring hood to the bottom of the truer arm. 1 illustr.

D *Nj Psfc*

Automatically grinding connecting rod bores

Keighley Grinders (Machine Tools) Ltd, Aireworth Rd, Keighley. *Mach Shop Mag* 1960 Vol 21 (3) pp 164-165 (Mar)

Grinding and sizing of big-end bores in connecting rods are done automatically on the Newall Keighley AK type internal grinding machine. Between rough and finish grinding the wheel is dressed automatically with a hydraulically operated diamond wheel dresser. 2 illustr. See also *Industr Diam Abstr* 1960 Vol 17 p A109 (Apr).

D *Agz Chcn Pr:Nj Psfb*

New grinder is really universal

Chambon Ltd, Standish Rd, London W 6. *Metalworking Prod* 1960 Vol 104 (11) pp 480-481 (Mar 16)

Easy changeover for various types of operation—cylindrical, internal, taper, surface, plough, spline and cutter grinding, as well as superfinishing, are among the features of a new universal grinder, the MSA 300. A micrometer diamond dressing attachment for internal grinding permits the grinding wheel to be dressed to a pre-set dimension, after which it is returned to its original setting by the feed indicator. 1 illustr.

D *Chc Pr:Nj Psf*

DIAMOND TECHNOLOGY

First published 1942 as "Production Methods for Diamond and Gemstone." The second edition of this book by P. Grodzinski has been revised throughout and considerably enlarged. 840 pages, 486 illustrations, 94 tables, and indexes. From NAG Press Ltd., 226 Latymer Court, London W 6. 54s 6d, post free.

USP 2,907,314 (Sep 22, 1955) **J. J. Osplack, Vinco Corp**

Grinding wheel dresser

A threaded grinding wheel is usually trued on a lathe, and the truing diamond moves along the tooth flank producing a pattern of ridges and hollows in a series of concentric circles. Such circles produce errors in the flanks of the teeth of the gear to be ground. Besides, this method of truing takes an undue amount of time, especially when gears are ground by the hobbing process (USP 2,607,175) in which the grinding wheel generates the complete tooth contour as each tooth rotates in mesh with the threads and is ground on both sides simultaneously. It is proposed here to true both flanks of a threaded grinding wheel simultaneously in order to shorten the operation and to pass the diamond along the 'line of action' of the rack of the grinding wheel and the gear to be ground. Such a line is normal to the flank of the thread and to the contacting surfaces of two mating gear teeth in the direction of pressure. For involute gears, the line of action represents the path of the contact point as the gears rotate. Fig 1 is a schematic view of the path of the truing diamond.

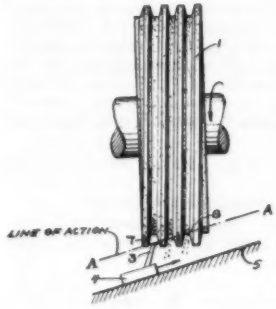
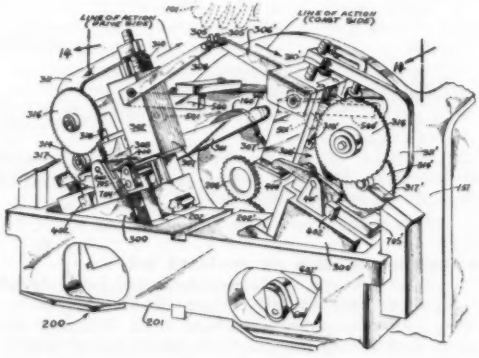


Fig 1 (left). Schematic view of the path of the truing diamond.

Fig 2. Perspective view of an apparatus for 'line of action' truing. USP 2,90,7314.



The truing process is much shorter, more accurate, causes much less diamond wear and leaves the wheel surface free-cutting for faster grinding. Fig 2 is a perspective view of an apparatus for 'line of action' truing with diamonds 305 and 305′ on truing unit 200. Main slides 300 and 300′ roll on ball bearings carried in grooves in guides 202, 202′. The movement of the slides is controlled by two cams (160 is shown) through followers (301 is shown with roller 302). (5 claims, 23 illustr). Ref cited : 4 USP.

J *Abmb Cg Nj Psf.545*

USP 2,907,315 (Aug 19, 1958) **O. E. Hill, Norton Co**

Truing apparatus

The apparatus is to true a radius, then a peripheral face, and finally a second radius on a wheel for crank pin grinding using a forming bar and a follower and synchronous driving connections between follower and truing tool. Fig 3 is a vertical section through the

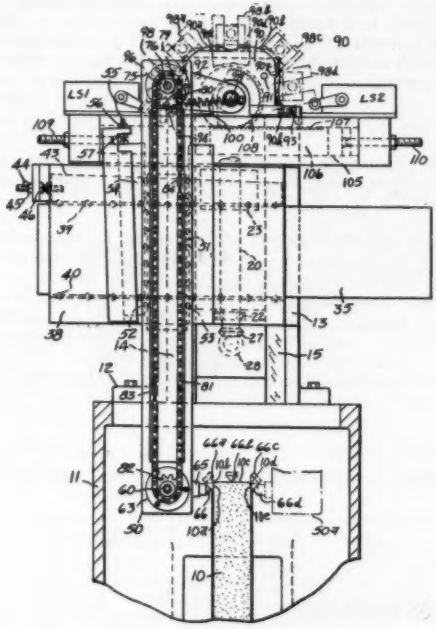


Fig 3. Vertical section through the truing apparatus. USP 2,907,315.

apparatus. Diamond 66 is guided around the profile of wheel 10 by follower 79 on forming bar 90 actuated by a mechanism comprising slide block 96 rotatable on shaft 76 sliding in slot 97 on rock arm 98. The mechanism is hydraulically actuated and electrically controlled. Synchronization is obtained between shaft 76 and shaft 60 for the truing tool mechanism by chain drive 81, 82. Single passes or several continuous truing strokes from left to right and back again, as in the case of the initial truing of new grinding wheels, are possible and need only the operation of certain switches in the electric control circuit. (14 claims, 5 illustr).

J *Ab Cg Njb Psf.545*

REQUESTS FROM AMERICA

American readers who wish to order a photostat or reprint of an article abstracted in Industrial Diamond Abstracts are advised to apply directly to the appropriate journal if this is an American publication.

USP 2,909,006 (Mar 24, 1955) **H. L. Blood, Heald Machine Co**

Grinding machine

The machine belongs to the class of automatic internal grinders with a truing cycle and adjustment by a work gauge. The difficulty in such machines is the compensation for thermal changes and the wear of the truing diamond. Minimum thermal changes are achieved by avoiding the use of hydraulic mechanisms and introducing an automatic adjustment of the length of the finishing feed, especially valuable when the diamond is indexed. The truing mechanism in Fig 4 and 5 shows the diamond 70 in fixed position on slide 8 which carries the workhead to be fed against wheel 4.

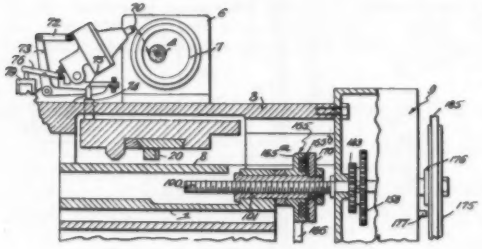
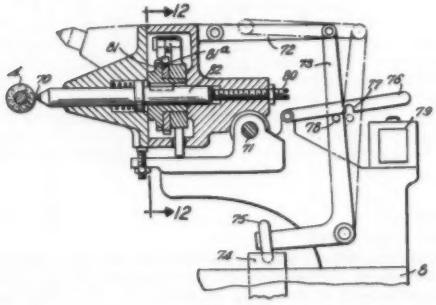


Fig 4 (above) and 5. Two views of the truing mechanism showing diamond 70 on slide 8. USP 2,209,006.



The diamond 70 is lowered about a pivot 71 into operative position as seen in Fig 5 and raised back by a link 72, rock arm 73 and follower 75 running over cam 74 on table 2. Set screw 80 serves for adjustment, ratchet device 81 for indexing the diamond after a number of cycles. Feed mechanism 9 is attached to slide 8 including feed screw 100. Electrically controlled clutches provide either fast or slow feed. Electric means, independent of rotation of feed screw 100, advance the work toward the wheel by a pre-determined amount during each cycle to compensate for reduction of the wheel diameter by wheel wear and truing. A feed dial 175 with automatically indexable slip ring 185 controls the feed in such a way that a pre-determined relationship is maintained between the reduction of feed for finish grinding and the termination of grinding. (43 claims, 22 illustr). Ref cited: 8 USP. *J* *Chcn Prs:Njb.545*

PRECISION MACHINING OF METALS

Mallory 1000—a new sintered material of great density and toughness. Mallory 1000—ein neuer Sinterwerkstoff hoher Dichte und Festigkeit

Johnson, Matthey & Co Ltd—Mallory Metallurgical Products Ltd, 73-83 Hatton Gdn, London EC 1. *FeinwTech* 1960 Vol 64 (2) p 72 (Feb) (In German)

This new sintered material combines considerable hardness with great toughness. Machining should be carried out as for cast iron, but compared with brass lower cutting speeds and feed speeds are recommended, while the tools should be sharpened more frequently. With precision grinding high surface qualities are possible and low tolerance precision threads can be ground. A mixture of 20 parts water to 1 part of cutting oil is recommended as a coolant.

K *Bkz Ceq/Bkz Unh*

Ultra-high-speed machining

G. H. DeGroat, A. Ashburn. *Amer Mach* 1960 Vol 104 (4) pp 111-126 (Feb 22)

Tests covered 641 AV titanium, 7075-T6 aluminium, AM-350 stainless and 4340 steel. Explosive was used as the power source at cutting speeds of 15,000 to 250,000 surface ft/min, with a few tests at up to 360,000. From most points of view, the best tool life was found in the 120,000 surface ft/min range. Results of this first phase of a manufacturing research programme being undertaken by the US Air Force are summarized. 31 illustr.

D *Bfa Chcz.1312*

Thread cutting tools. Gewindeschneidwerkzeuge

Liebaug & Nimscholz Praezisionswerkzeugfabrik, Gruiten. Rhld. *FeinwTech* 1960 Vol 64 (2) p 74 (Feb) (In German)

K *Ceqbd Pd*

Drilling cross holes in round rod

E. D. Ward. *Mach Shop Mag* 1960 Vol 21 (3) p 166 (Mar)

2 illustr. *D* *Agz Cfb*

Transmission elements cut on Shear-Speed

G. H. De Groat. *Metalworking Prod* 1960 Vol 104 (11) pp 482-483 (Mar 16)

Describes use of the Shear-Speed gear cutting process, developed by Michigan Tool Co to produce toothed elements on car transmission parts. 4 illustr.

D *Ad Ceg*

Ultra-high tensile steels are machined hot

R. A. Scott (North American Aviation Inc). *Metalworking Prod* 1960 Vol 104 (11) pp 484-485 (Mar 16)

Preliminary work with carbide tools indicates that metal is removed faster, work-hardening eliminated, and tool life increased, when ultra-high tensile steels are machined hot. Machining with solid carbide or carbide-tipped cutters, at temperatures up to 1,200° F, is being evaluated. 4 illustr.

D *Bfdz Ceq Pdc*

'Throw-away' tip tool applications

A. W. Astrop. *Machinery, Lond* 1960 Vol 96 (2468) pp 473-475 (Mar 2)

Some examples of set-ups at the works of British Timken where 'throw-away' tip tools are being employed for machining cups and cones for tapered roller bearings. 3 illustr. *X* *Pdcbz*

The application of sintered carbide tools. Zur Verwendung von Hartmetallwerkzeugen

Anon. *Technica* 1960 Vol 9 (7) pp 327-329 (Mar 25) (In German)

Discusses the machinability of materials, cutting forces, and cutting conditions, as well as giving directions for the care of machines and prevention of accidents. 8 illustr. *K* *B Unp*

Now—successful ceramic milling

R. M. Gill. *Metalworking Prod* 1960 Vol 104 (12) pp 514-517 (Mar 23)

Ceramic tipped milling cutters are being used at Alvis Ltd, Coventry, for regular production operations on standard machines. Better finish, faster times and lower tool costs are reported to be achieved. 4 illustr. *X* *Cfj Pdd*

Clamped tools for sintered carbide and high speed steel. Klemmwerkzeuge fuer Hartmetall und Schnellstahl

Anon. *Industr Anzeig* 1960 Vol 82 (19) pp 288-289 (Mar 4) (In German)

Decided advantages over permanent brazed junctions are claimed for these tools. They consist of two parts, the holder and the cutting insert. For re-grinding, the cutting insert needs only be removed from the holder, which remains in the machine. 1 illustr. *K* *Pdbb/Pdcb*

Determining the centre of boreholes. Mittelpunktbestimmung an Bohrungen

Anon. *TZ prakt Metallbearb* 1960 Vol 54 (3) p 103 (Mar) (In German)

Describes a tool which enables the centre of large diameter boreholes and sections of tubing to be determined simply but accurately. 1 illustr. *K* *Az Cfz Wb*

Axial clamping of workpieces to be machined on lathes or grinding machines. Axialspannung von Werkstuecken zur Bearbeitung auf Drehmaschinen und Schleifmaschinen

J. Lukowski. *TZ prakt Metallbearb* 1960 Vol 54 (3) pp 128-129 (Mar) (In German)

In some cases radial clamping is undesirable and axial clamping must be used. Examples are given of different methods, suitable for various grinding and turning processes. 4 illustr. *K* *Ceqb Pr Psh/Chc Pr Psh*

The maintenance of machine tool accuracy—Pt I

F. H. Slade. *Mach Lloyd* 1960 Vol 32 (5A) pp 19-25 (Mar 5) (In English, abstrs in German and French)

5 illustr. *D* *Pr.139*

Blind-hole tapping can be painless

J. W. Turton. *Amer Mach* 1960 Vol 104 (5) pp 96-99 (Mar 7)

Blind holes should be eliminated at the design stage if possible, but, if they are unavoidable, causes of trouble in tapping can be lessened by observing certain advice given here. 9 illustr. *D* *Az Cfz.1456*

Machining high temperature alloys

J. H. Schwertz. *Tooling & Prod* 1960 Vol 25 (11) pp 51-52 (Feb)

Cutting tool materials are considered in four groups: high speed tool steels, ceramics, cermets, and sintered carbides. A machinability study was made on Waspaloy as a representative composition of the high nickel base alloys. Results are reported. 1 illustr. *D* *Bfxz Ceq Pd*

Machining stainless steel

G. J. Stevens. *Mod Mach Shop* 1960 Vol 32 (10) p 126 (Mar)

A modified drill grind solves an oversize hole problem in machining ¼ in. bushings from Type 440F stainless steel rounds in a Browne & Sharpe automatic. 1 illustr. *D* *Az Bfdb Ceq*

Machining tungsten

P. G. Barrho. *Tooling & Prod* 1960 Vol 25 (11) pp 56-58 (Feb)

4 illustr. *D* *Bfp Ceq*

Want to increase boring production? . . . Inserts may help

D. H. Joyce. *Carbide Engng* 1960 Vol 12 (2) pp 18-21 (Feb)

Examples of savings made when throwaway insert tooling was applied to boring operations. 5 illustr. *D* *Cfb Pdcb*

Development of metal cutting methods in the German Democratic Republic

N. N. Zorev. *Vestn mash* 1958 (3) pp 77-81; *LLU Transl Bull* 1960 Vol 2 (3) pp 212-220 (Mar) (Original in Russian)

13 illustr. *D* *Bf Ceg.1456:.132.322*

Universal boring attachment. Universal-Bohrvorrichtung

H. Walther. *Werkst u Betr* 1960 Vol 93 (2) p 90 (Feb) (In German)

3 illustr. *K* *Cfd Psc*

Electronically controlled borer. Elektronisch gesteuerte Bohrmaschine

EMI Electronics Ltd, Hayes, Middx. *FeinwTech* 1960 Vol 64 (2) p 73 (Feb) (In German)

A particularly strong, electronically controlled boring machine has been developed. It is claimed that this machine considerably reduces production time and that it renders unnecessary the boring of a guide hole in order to maintain low tolerances. *K* *Cfd Pr Wpz*

Two-machine team boosts production

Lycoming Div, Avco Corp, Stratford, Conn. *Grinding & Finishing* 1960 Vol 6 (2) p 34 (Feb)

Describes boring, facing, chamfering and finish grinding of six bearing diameters in steel carrier assemblies, at a rate of 7 parts/hr and with 80% efficiency. The operations are started on a Heald Model 221 Bore-Matic and finished on a Heald Model 2712 internal grinder. 1 illustr. *D* *Ad Ceq Pr*

A new optical screw cutting tool setting and profile gauge

Heinrich Schneider, Optotechnische Fabrik, Bad Kreuznach, Germany. *Mfg Optic* 1960 Vol 13 (5) pp 236-237 (Mar)

See *Industr Diam Rev* 1959 Vol 19 (221) pp 71, 74, 79 (Apr).

1 illustr. *D* *Ceqbd Pd Wb*

Producing grease retaining rings

B. West. *Mod Mach Shop* 1960 Vol 32 (10) pp 120-121 (Mar)

A new Jones & Lamson twin-spindle precision boring machine is designed for machining a wide variety of workpieces to a high degree of accuracy. Performance is illustrated by a description of machining a stainless steel grease retaining ring inside and outside to close tolerances in a 20 sec cycle. 3 illustr. *D* *Cfd Pr.139*

Precision high speed drill press

Rockwell Mfg Co, Walker-Turner Div, Dept WL-22, 400 N Lexington Ave, Pittsburgh 8, Pa. *Mod Mach Shop* 1960 Vol 32 (9) pp 274, 276 (Feb)

The 14 in. Hi-Speed Drill Press is for small hole precision drilling and is said to be ideal for manufacturers of jewellery, electronic devices and similar equipment. It is recommended for all drillable materials, particularly precious metals, non-ferrous metals, *etc.* It is available in single or multi-spindle models. 1 illustr.

D *Bfh Cfb Pr/Bff Cfb Pr*

Tornado radial arm drill

Cooper Brothers (Stockport) Ltd, Precision Works, Shrewsbury St, Stockport, Cheshire. *Metalworking Prod* 1960 Vol 104 (9) pp 398-399 (Mar 2)

The machine can drill and ream work up to ½ in. diameter, and has eighteen indicated speeds. The drill head may be tilted and locked in position for drilling holes at any angle up to 45 degrees. Other features are described. 1 illustr. *D* *Cfb Pr*

The 'Magnetrace' automatic profiling machine. Machine automatique à profiler 'Magnetrace'

New England Machine & Tool Co. *Mach Mod* 1960 Vol 54 (612) pp 75-76 (Mar) (In French)

1 illustr. *K* *Ceqg Prs*

Schiessl UWM universal machine tool. Schiessl-Universal-Werkzeugmaschine UWM

Anon. *Maschinenwelt u Elektrotechnik* 1960 Vol 15 (4) p 152 (Mar) (In German)

This newly developed machine is intended not only for the individual production of different kinds of workpieces, as for instance in laboratories and test workshops, but as an adaptable single or multi-purpose machine for the carrying out of similar processes in mass production. Among the processes which it can carry out are drilling and jig drilling and in emergency it can also be used for grinding.

See also *Industr Diam Abstr* 1960 Vol 17 p A69 (Mar).

K *Pr.142*

Grooved hole machining aids high pressure designs

Cogsdill Tool Products Inc, Oak Park, Mich. *Carbide Engng* 1960 Vol 12 (2) p 38 (Feb)

A spring-loaded cutting tool, the Bak-Sink, which produces a groove in a hole automatically, is being used for machining a multiplicity of grooved holes in heat exchanger tube sheets. The tool is mounted in a spindle of a programmed drilling machine which positions it in front of the hole to be groove-machined. The operation is described.

D *Az Cfb Pdz*

One-shot machining of mandrels

American Air Filter Co, Louisville. *Amer Mach* 1960 Vol 104 (5) pp 91 (Mar 7)

A single machine with a specially designed Morse Twist Drill cutting tool has replaced several turret lathes and many normal operations in machining both ends of a spool mandrel simultaneously. Machining time per mandrel is cut from 8.2 min to 0.73 minute. Tolerances from −0 to +0.001 in. are said to be obtained without increasing cost. 3 illustr.

D *Alp Ceq Pr*

Machining components for the new Ford Anglia

Anon. *Machinery, Lond* 1960 Vol 96 (2468) pp 464-472 (Mar 2)

9 illustr. *D* *Az Ceq*

Sunnen expands its line of small hole honing tools

Sunnen Products Co, Dept E-3, 7910 Manchester Ave, St Louis 17, Mo. *Amer Mach* 1960 Vol 104 (5) p 158 (Mar 7)

Honing mandrels and stones are available from stock for bore diameters from 0.100 to 0.118 in. in increments of 0.002 inch. *E* *Pgk*

CUTTING & MACHINING OF STONE, ETC

Grinding ceramic materials with bonded abrasives

T. P. Kapustina, A. A. Bykova. *Steklo i Keram* 1959 Vol 16 (7) pp 12-15; abstr *J Amer ceram Soc* 1960 Vol 43 (3) p 67 (Mar)

The use of bonded abrasives for grinding planar details into ceramics was investigated to select a suitable working cycle for the wheel. The grinding process may be done with large surface exposure and slow speeds or vice versa. The selection of the method depends on the required fineness of detail and the technique used to make the ceramic, *ie* casting or pressing. *D* *B! Chc Rd Ur*

A method for the accurate fitting and automatic grinding of bi-focal glasses. Eine Methode zum exakten Anpassen und automatischen Einschleifen von Mehrstaerkenglaesern

K. Schlecht. *Augenoptiker* 1959 Vol 14 (8) p 10; *Feinmechanik u Optik* 1960 Vol 77 (3) p 95 (Mar) (In German)

K *Bm Chc Tfbz*

Crystal slicer

Robert E. Morris Co, REM Sales Div, 5004 Farmington Ave, West Hartford 7, Conn. *Mach Shop Mag* 1960 Vol 32 (9) pp 254, 256, 258-259 (Feb)

A compact automatic precision crystal slicing machine combines a variable feed downward plunge with a synchronized automatic increment cross feed. It is claimed that plunge cutting offers the shortest feed stroke, with substantial time saving due to the slow feeds needed for precision wafering of germanium, silicon, quartz, *etc.* The plunge cut brings the diamond-charged slicing blade to the work, allowing the crystal boule to be mounted rigidly and supported during the cutting operation. The machine comes in several models. Various features are described. 1 illustr.

D *Bd Cej Ngb Pr*

Machine for drilling fine holes in hard materials

Mécanique et Plastique SA, 114 Rue de Carouge, Geneva. *Wire & Wire Prod* 1960 Vol 35 (2) p 241 (Feb)

A new machine drills ultra-fine holes in hard materials such as synthetic jewels, rubies, wire drawing dies, and injector and other nozzles. A group of 30 MP machines can drill 8,000 to 12,000 holes in 8 hr under the control of one operator, it is claimed. The work is done automatically and holes are said to be uniform and smooth. *D* *Ba Cfb Pr*

0.04″ squares, 0.0015″ thick gaged and sorted automatically

J. P. Philbin, W. B. Finnegan. *Tooling & Prod* 1960 Vol 25 (11) pp 47-48 (Feb)

An account of how 0.04 in. square and 0.0015 in. thick germanium and silicon base wafers for transistors are measured and sorted automatically at very high speeds on a machine designed and built by Airborne Instruments Laboratory.

D *Az Bfr Cdd Pr/Az Bhc Cdd Pr*

New lens edger and buff

L. A. Mower & Sons; Sole agents: Alfred Mills (Opticians) Ltd. *Mfg Optic* 1960 Vol 13 (5) p 235 (Mar)

The fast-cutting grinding wheel can be used in either direction. There is a truing device of new design and provision for independent adjustment of belts. The machine is claimed to cut maintenance costs and increase productivity. 1 illustr.

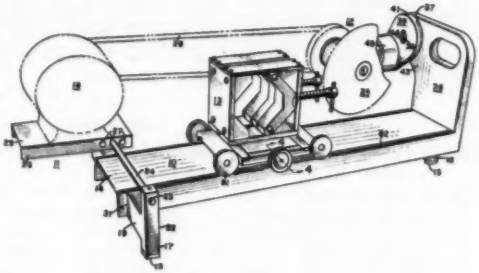
D *Bm Chcs Pr*

GEM POLISHING

USP 2,909,169 (July 17, 1957) **P. A. Vonada**

Multi-purpose lapidary device

For working gemstones the basic rotary operations used are: sawing, grinding, sanding, polishing, lapping, faceting. For each operation individual lapidary units exist which are, however, expensive and require space so that the amateur lapidist would appreciate a multi-purpose unit. Up to now no such unit has been satisfactory. Figs 6 and 7 represent a unit which



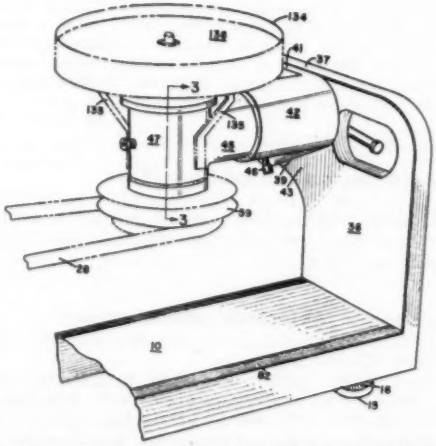


Fig 6 (top). Diagram of the unit showing diamond saw 35. Fig 7. Set-up for lapping on wheel 136. USP 2,909,169.

permits all operations including sawing with a (diamond) saw 35 or lapping on wheel 136 while the workpiece can be clamped in the removable vise 13 or located inside splash guard 134. 18 is the electric motor for driving the tools mounted on adjustable L-shaped support 39. (8 claims, 6 illustr). Ref cited: 12 USP. *J* *Bb Ce Pr.545:F Hl J Pr.545*

ROCK DRILLING

Step nearer the Mohole

Anon. *New Scientist* 1960 Vol 7 (176) pp 769-770 (Mar 31); *Observer* (Mar 27); *Min J* 1960 Vol 254 (6502) p 377 (Apr 1)

A combination of turbo-drill and diamond cutting bit is likely to be used for boring 18,000 ft through the ocean floor to reach the Mohorovicic discontinuity. The Mohole project, which began in 1957, may become definite in July, 1960, at the Helsinki meeting of the International Union of Geodesy and Geophysics. Support from American firms has been complemented by an offer from Industrial Distributors (1946) Ltd to supply the necessary industrial diamonds, while Christensen Ltd have agreed to produce special diamond bits.

The project will have two stages, the first being to penetrate 1,000 to 2,000 ft of soft sediment at the sea bed to reach the hard rock below. A secondary aim at this stage is to recover continuous cores. If this preliminary work is successful, drilling through four miles of rock can be attempted. Drilling at sea will present special difficulties, but this is counter-balanced by the fact that the earth's crust is thinnest under the ocean: beneath the continents it is some twenty miles thick and beneath the oceanic islands about ten miles.

Support for the project by oil companies is expected to pay practical dividends in improvements to drilling techniques and equipment.

See also *Industr Diam Abstr* 1959 Vol 16 p A212 (Nov); p A237 (Dec).

D *Bnt Cfb Nh*

Coalbrook North

Anon. *S Afr Min & Engng J* 1960 Vol 71 Pt 1 (3495) p 219 (Jan 29)

A diamond drill, said to be the fastest in the world, was used in an attempt to reach possible survivors of the Coalbrook North colliery disaster. The drill rig had been developed in an effort to produce a core drilling machine, which would go down 15,000 ft and which would cut down on the time needed for pulling and lowering rods.

See also *Industr Diam Abstr* 1959 Vol 16 p A133 (July). *D* *Nh*

A half century of progress in metal mining—2

G. K. Allen. *Min Mag, Lond* 1959 Vol 101 (5) pp 232-246 (Nov)

In sub-level stoping, ring drilling is done by both diamond drills and percussive machines with jointed or flexible drill rods. 5 illustr.

D *Bf Cb.132*

Rotary drills in coal mining

B. A. Katanow, M. S. Safochin. *Sowjet Buchneuerscheinungen, Vorankuendigungsdienst,* 1960 (4) p 27 (Abstr in German, original in Russian)

Book, Gosgortechisdat. 1960, 128 pp. Price DM 1.50. [Not in library of Industrial Diamond Information Bureau]. *K* *Bz Cb Plz*

What's new in drilling

Anon. *World Oil* 1960 Vol 150 (3) pp 130-134, 136 (Feb 15)

6 illustr. *D* *Cfb*

Cementing diamond drill holes

P. B. Hall. Extract from *Canad Diamond Drilling 14th Assoc Annual Mtg, Toronto; 'Mindrill' Bits & Pieces* 1960 Vol 12 (10) pp 2-3 (Feb)

D *Az Nh*

Belt sander works in all positions

Millers Falls Co, Wells & Deven Sts, Greenfield, Mass. *Purchasing Week* 1960 Vol 3 (8) p 22 (Feb 22)

Sander uses 4 × 21 in. belt to eliminate drive wheel wobble in any sanding position—vertical, overhead, or horizontal. Design permits flush sanding up against right-angle surfaces. Belt changes with quick lever action. *X* *Pee:Chf Pr*

Large diamond drill

Mindrill Ltd, Melbourne. *Mine & Quarry Engng* 1960 Vol 26 (2) pp 84-85 (Feb)

A description of Mindrill model F 150 diamond drill. 1 illustr.

See *Industr Diam Abstr* 1960 Vol 17 p A43 (Feb).

D *Nh*

Mindrill Tri-set and full circle diamond core heads

Anon. *'Mindrill' Bits & Pieces* 1960 Vol 12 (10) pp 4-5 (Feb)

Mindrill Tri-Set bits, available in solid or coring types, feature three flat surfaces on the circle : this is said to have several advantages over a full circle bit, including increased safety because of virtual elimination of swabbing and hydraulic action when pulling out or running in the hole. The importance of selecting the right diamond coring heads in order to achieve 100% core recovery is stressed. Among factors to be weighed before selection are condition of the hole, type of drilling mud and rock formation, type of core barrel, and maximum fluid volume obtainable. 1 illustr.

D *Cfb Nhe.21*

WIRE DRAWING

Fine gauge wire multiple-drawing machine

F. Bergfeld, Ihmert/Westf, Germany. *Wire World Int* 1960 Vol 2 (1) p 29 (Feb)

A fine gauge wire drawing machine has been developed for the manufacture of thin steel or metal wires of 0.20 to 0.02 mm diameter. The wire passes from the coil into the machine, which has either two cylindrical steel rollers or stepped rollers ; between the rollers is the drawing die stone holder for 24 diamond dies. The dieholder is moved to and fro continuously to limit the cutting of the wires on the drawing roller. The drawing roller can be cleaned easily for re-grinding. Drawing speed can be adjusted during operation to a ratio of 1 : 6 or 1 : 12 so that both hard and soft wires can be drawn. 1 illustr.

D *An Bf Cn Mf Nkb Pr*

Non-ferrous metals in radio valves

Mullard Group. *Metal Ind, Lond* 1960 Vol 96 (11) pp 211-213 (Mar 11)

A large section in the Blackburn plant is devoted to the manufacture of tungsten and molybdenum wire, the finest of which has a diameter of 5 thousandths of an inch. The diamond dies used in the final drawing stages are made by the company. Gas is used extensively throughout the drawing operations. 8 illustr.

D *An Bfp Cn Nkb/An Bfq Cn Nkb*

GRINDING AND POLISHING OF CARBIDES AND METALS

Increasing grinding efficiency by vibration of the grinding wheel

G. K. Demisev. *Steklo i Keram* 1959 Vol 16 (10) pp 27-31 ; abstr *Inhaltsverzeichnisse sowjet Fachzeits* 1959 Vol 8 (12) p 485 (Dec) (Original in Russian, abstr in German)

Discusses experiments made to determine the effect of ultrasonic and low frequency vibration of the grinding wheel. Ultrasonic grinding wheels can be used for machining sintered carbides, minerals and ceramics, while low frequency grinding proved suitable for use with sheet glass. The reduced frictional force involved allows a reduction in power on the grinding machine motor. *K* *Chc Qn.21*

Application of electron microscopy : Thin films and their use in metallurgy

A. Saulnier, P. Mirand. *Metal Treatm* 1960 Vol 27 (174) pp 91-100, 102 (Mar)

Describes a method of preparing very thin films which is applicable to most metals and alloys. The first stage is mechanical reduction to a thickness of a few hundreds of a millimetre. The prepared specimen is then polished electrolytically several times until the fragments have a thickness of a few hundred Å and will give good electronic images. 20 illustr.

D *Bfa Chmk*

The advanced manufacturing methods behind the Army's FN rifles. Pt 1

J. A. Weller. *Canad Min J* 1959 Vol 70 (9) pp 87-91 (Sep)

Close attention is paid to tool grinding throughout the metal cutting departments of Canadian Arsenals Ltd. Among interesting examples of the latest equipment, the Everite electro-chemical tool grinder has greatly reduced the rate of wheel wear. On a full shift basis only 0.001 in. of wheel surface is worn away per week, and wheel costs are now only about ¼ of their previous value. In the machine, electricity passes between the tool and the wheel so that electrolytic action assists the metal bonded diamond wheel in its cutting action. 12 illustr. (To be cont).

D *Al Chc Pr:Nv Urc*

Standard time data for grinding—Pt III

E. A. Cyrol, R. L. Borck. *Grinding & Finishing* 1960 Vol 6 (2) pp 36-39 (Feb)

Covers the application of the data to cylindrical grinding. 3 illustr. *D* *Chcl.21*

The nature of mechanically polished surfaces

L. E. Samuels. *Bull Brit non-ferr Met Ass* 1960 Vol 40 (368) pp 123-124 (Mar)

Book, 46th Annual Technical Proceedings of the American Electroplaters' Society, ASE, 445 Broad St, Newark, NJ. 1959, 400 pp. Price $25.--.

The author's work has shown that flow does not occur in mechanical polishing as normally practiced but primarily by cutting, the resulting surface being crystalline but deformed. The structure of this surface-deformed layer is considered, as is its possible influence on coatings plated on it.

[Not in library of the Industrial Diamond Information Bureau].

See also *Industr Diam Abstr* 1959 Vol 16 p A88 (May).

M *Az Chm.21*

Automatic honing in conveyor-linked line

D. Scott. *Metalworking Prod* 1960 Vol 104 (12) pp 521-523 (Mar 23)

Transfer from a continuously moving looped-track conveyor to a fully automatic honing machine is effected by a special indexing loader and intermediate chutes on the linked line producing cylinder liners for the Renault Dauphine car. 5 illustr.

X *Chh Prs*

Why honing ? Pt I

M. M. Patterson. *Grinding & Finishing* 1960 Vol 6 (2) pp 28-31 (Feb)

Describes fundamentals, advantages, and applications of the method. 20 illustr. (To be cont).

D *Chh.21*

Grinding holes in end mills

Anon. *Grinding & Finishing* 1960 Vol 6 (2) p 17 (Feb)

Answer to reader's question.

A mounted wheel or point is suggested for the grinding of ⅛ to ¼ in. diameter holes in HSS end mills. A high speed spindle, up to 100,000 rev/min would be needed, with a collet chuck to accommodate the wheel spindle. Wheel specifications are given.

See also *Industr Diam Abstr* 1959 Vol 16 p A135 (July). *D* *Alcz Bfdg Chcn Peh*

Diamond wheel testing

Anon. *Grinding & Finishing* 1960 Vol 6 (2) p 17 (Feb)

Answer to reader's question.

In order to compare costs of various makes of diamond wheels used for grinding carbide wheels, and because of the variety of shapes and sizes of carbide tipped tools usually found in a single plant, it is suggested that testing be confined to the diamond wheel cost for a definite amount of solid carbide.

See also *Industr Diam Abstr* 1960 Vol 17 p A6 (Jan).

D *Nv.1312*

How's your buffing average ?

S. Sax. *Grinding & Finishing* 1960 Vol 6 (2) pp 43-45 (Feb)

The characteristics of various buffs and compounds are described. 4 illustr. *D* *Chz.21*

Grinding and lapping ceramic cutting tools. [Scheifen und haeppen von Keramischen Scheidwerkzeugen]

L. K. Petrosjan. *Tech Rdsch* 1959 Vol 51 (29) pp 19-23 ; abstr *Werkst u Betr* 1960 Vol 93 (2) p 106 (Feb) (In German)

K *Al Bl Chc/Al Bl Chd*

Centreless grinding of thin axles

Anon. *Eurotec* 1960 (6) p 6 (Mar) (In English, abstrs in French, German and Italian)

1 illustr. *K* *Az Chcc*

The latest in automatic crankpin grinders . . .

F. K. Jones. *Grits & Grinds* 1959 Vol 50 (11) pp 8-13 (Nov)

Describes the Norton No 2 unitized transfer type crankpin grinding machine, said to offer big cost-saving advantages and to eliminate fatigue factors. Each station is equipped with a diamond truing device. 6 illustr. *D* *Agn Chc Prs*

Sharpening device for chain saws

J. S. Semcuk. *Les Prom* 1959 Vol 37 (9) pp 15-16 ; *Inhaltsverzeichnisse sowjet Fachzeits* 1959 Vol 8 (11) pp 439-440 (Nov) (Original in Russian, abstr in German)

K *Alz Chc Psc*

Grinding machine for intaglio-printing copper cylinders

A. A. Volkov. *Poligr Proizvod* 1959 (8) p 18 ; *Inhaltsverzeichnisse sowjet Fachzeits* 1959 Vol 8 (11) p 445 (Nov) (Original in Russian, abstr in German)

K *Agc Bfh Chc Pr*

Bennett SG twin head spring-end grinder

Bennett Tools Ltd, Arthur Street, Redditch. *Metalworking Prod* 1960 Vol 104 (11) p 490 (Mar 16)

Rough and finish grinding of both ends of compression springs is done in one pass on a Bennett SG twin head spring-end grinder. The machine handles springs up to 1½ in. diameter with a wire range up to 0.016 in. and lengths from ¼ in. to 5 inches. With wheels 2 in. thick and 6 in. diameter, instead of 4 in. thick and 10 in. diameter as normally used, lengths up to 6 in. can be taken. Dressing of both rough and finishing wheels is done by two externally operated built-in diamond dressing units. 1 illustr. *D* *Az Chc Pr*

Large Mattison abrasive belt grinders

Mattison Machine Works, Rockford, Ill ; British rep : Gaston E. Marbaix Ltd, Devonshire Hse, Vicarage Crescent, London SW 11. *Machinery, Lond* 1960 Vol 96 (2468) pp 491-492 (Mar 2)

Abrasive belt grinders in the No 456 range enable titanium, stainless steel and carbon steel sheets to be ground to close tolerances for thickness at a single pass. It is stated that surface finish is such that subsequent hand finishing is unnecessary. 1 illustr.

D *Chc Pee Pr*

Elliott machine tool demonstration

B. Elliott (Machinery) Ltd, Victoria Works, London NW 10. *Machinery, Lond* 1960 Vol 96 (2468) pp 505-506 (Mar 2)

Among exhibits was the Elliott-Excel No 5 tool and and cutter grinder, fitted with a new heavy-duty workhead which can accommodate milling cutters up to 14 in. diameter. The Elliott-Milford range of double-ended grinders has been extended to take wheels of 6, 7 and 8 in. diameter by ¼ in. wide. They are supplied for bench mounting or with pedestal bases. 2 illustr.

D *Al Chc Pr*

' Centuramic ' centreless grinder for the small workshop. Rectifieuse centerless ' Centuramic ' pour l'atelier artisanal

Cincinnati Milling Machine Co. *Mach Mod* 1960 Vol 54 (612) p 75 (Mar) (In French)

This new centreless grinder, the 210-6, was specially designed for small scale production and for rapid changing of workpieces. Workpieces of a maximum external diameter of 76 mm are admitted, and the normal size of the grinding wheels is 152 mm, although wheels of up to 200 mm can be used. Centuramic machines are equipped with automatic truing and profiling devices. *K* *Chcc Pr*

Manex optical jig boring and grinding machine

Pollard Machine Tools Ltd, Oozells St, Birmingham 1. *Machinery, Lond* 1960 Vol 96 (2468) pp 488-489 (Mar 2)

When the machine is set up for internal grinding, holes ranging in diameter from $\frac{1}{16}$ to 4 in. can be precision ground with diamond impregnated studs or mounted grinding wheels. 2 illustr.

D *Cfd Pr Pu/Chc Pr Pu*

Machine tools and equipment

Newall Keighley. *Times Rev Ind* 1960 Vol 14 (158) p 33 (Mar)

The HAC crankpin grinder grinds two crankpins simultaneously with separate wheels, on small and medium-size crankshafts for four and six cylinder engines. Grinding wheels up to 42 in. diameter can be mounted on the Nitralloy spindle. When the wheelhead has been moved clear at the end of a grinding cycle, truing begins automatically and continues while another crankshaft is being unloaded between the workheads. The wheelhead is adjusted automatically to compensate for reduction in wheel diameter due to truing.

D *Agn Chc Pr*

Machine tools and equipment

J. L. Jameson Ltd, Ewell, Surrey. *Times Rev Ind* 1960 Vol 14 (158) p 33 (Mar)

Designed for the printing industry, a diamond turning lathe for copper coated gravure cylinders is said to give a high degree of parallelism and surface finish. Cylinders up to 15 in. diameter can be handled, and the maximum distance obtainable between the faces of the collets is 62 inches. 1 illustr.

D *Ag Bfh Ceqb Nf Pr*

Universal tool grinder with new hydraulic table drive. Universal-Werkzeugschleifmaschine mit neuem, hydraulischem Tischantrieb

L. Kellenberger & Co, St Gallen. *Technica* 1960 Vol 9 (7) pp 319-321 (Mar 25) (In German)

Describes a universal grinding machine which can be used for grinding and sharpening a wide variety of chip producing tools. The hydraulic table drive allows a considerable extension of the machine's range of application, it is claimed. 10 illustr.

K *Al Chc Pr*

Air-floating spindle speeds tool grinding

Steptool Corp, Los Angeles, Calif. *Grinding & Finishing* 1960 Vol 6 (2) p 59 (Feb); *Carbide Engng* 1960 Vol 12 (2) p 32 (Feb)

The Air-Flo fixture, for sharpening end mills and routers, is said to work virtually without spindle friction due to a porting system designed to eliminate metal contact of the spindle, which floats on a cushion of air. The attachment also grinds straight or tapered end mills both on periphery and ends. Other applications are listed. 1 illustr.

D *Al Chc Pr Pslz*

Automatic grinding machine for metal cutting saw blades

W. Von Arnauld Co, 95 St Oakland, MJ. *Mod Mach Shop* 1960 Vol 32 (9) pp 196-197 (Feb)

The latest in the Tempo line, Model AS-12, grinds segmental and carbide tipped circular saws with a capacity of up to 49 in. circular saw diameter. The machine can index exactly on the tooth to be ground, it is claimed, and eight index speeds are available. All Tempo machines have a shift arangement to grind either straight or curved tooth profiles. 1 illustr.

D *Alz Chc Pr*

Improved insert grinding technique

Allied Tool Products Inc, 2105 West Auer Ave, Milwaukee 6, Wisc. *Carbide Engng* 1960 Vol 12 (2) p 33 (Feb)

A new grinding technique converting negative rake throwaway carbide inserts to effective positive rake angles results in approximately 50% savings over the cost of positive rake inserts, it is said. It is now possible to obtain the technical advantages of positive rake angles with the economic advantages of negative rake inserts by utilizing all cutting edges of inserts. Actual field tests with these new ground inserts have revealed lower cutting pressures and longer tool life. 1 illustr.

D *Al Bk Chc*

Effective use of the honing machine. Zweckmaessiger Einsatz der Honmaschine

Anon. *Maschinenwelt u Elektrotechn* 1960 Vol 15 (4) pp 127-129 (Mar) (In German)

Honing machines have been used with ever-increasing effect in the machining of boreholes. The advantages of this over other methods are discussed and a table shows the performance of various machines. 5 illustr, 1 table.

K *Chh Pr*

Rudkin & Riley grinding machine

Rudkin & Riley Ltd, Cyprus Rd, Aylestone, Leics. *Mach Shop Mag* 1960 Vol 21 (3) p 177 (Mar)

Type 2013 precision grinder grinds bores ranging in diameter from 0.04 in. to 3.5 in. and external diameters up to 3 inches. Also available for use with this machine is a new kind of lap which is claimed to be suitable for obtaining a micro-finish after internal or external grinding. When the machine is used for external grinding, the steady-rest and diamond truing tool are mounted on a slide bar at the rear and can be adjusted longitudinally. A special additional attachment does radius grinding, *eg* on wire and small tube drawing dies. 1 illustr.

D *Chc Pr*

Eccentric carrier feeds centreless grinder

Arthur Scrivener Ltd. *Metalworking Prod* 1960 Vol 104 (9) p 393 (Mar 2); *Machinery, Lond* 1960 Vol 96 (2468) p 504 (Mar 2)

An eccentric ring feeder has been developed to feed components, such as numeral wheels for industrial counters, to centreless grinders. Typical production rate is claimed to be 4,000 pieces/hr with stock removal up to 0.018 inch. The system is said to ensure concentricity and squareness of the outside diameter with the hole in the wheel, as well as accuracy on size.

D *Chc Pr Pspz*

Motorized fixture for OD, ID, form grinding of cylindrical parts

Products Supply Co, 1178 Woodward Heights Blvd, Ferndale 20, Mich. *Carbide Engng* 1960 Vol 12 (2) p 32 (Feb)

A compact motorized fixture that enables through-feed or form grinding operations to be performed on cylindrical parts with conventional surface grinders is now available. It can be used for either production or toolroom operations. The device utilizes a unique outside diameter driving and adjustable roller clamping arrangement that provides concentricity and avoids the use of centres, chucking devices, or indicators, it is claimed. It is adapted to the production of precision forms on cylindrical parts from 0.005 in. to 3 in. diameter. 1 illustr.

D *Ag Chcb Psc Psj*

USP 2,909,007 (Apr 20, 1956) **R. Tettke sen, Bendix Aviation Corp**

Treatment of inner surfaces of arcuate tubes

For certain instruments, *eg* turn and bank indicators in aircraft, trim indicators on ships, ball type inclinometers are used with a ball rolling in a bent glass tube. Slight unevenness of the interior will cause inaccurate readings and as such defects are usually formed while bending the tube, a lapping process is introduced after the bending step, in which an elongated copper slug and a lapping compound solution of silicon carbide grains is inserted in the tube, which is then sealed at the ends and rocked back and forth. (4 claims, 3 illustr). Ref cited : 6 USP ; 1 Swed P.

J *Ag Chd.545*

USP 2,909,009 (July 22, 1954) **W. D. Schmidt, A. F. Townsend, Heald Machine Co**

Grinding machine

In machines for grinding simultaneously the inner and outer diameter of round workpieces, such as cylindrical or tapered ball or roller bearing rings, within tolerances of fractions of a thousandth of an inch, the difficulty of supporting the workpiece has been overcome by providing a centreless support for the workpiece with at least two fixed support elements defining a support-determined axis for a workpiece of certain size, and with a rotatable magnetic back-plate normal to the axis of the workpiece. The external and the internal grinding wheels are fed automatically and simultaneously but so that the external tool is first brought to a finishing position which determines afterwards the finishing position of the internal tool. (13 claims, 8 illustr). Ref cited : 10 USP.

J *Ag Chc Pr.545*

MACHINING DEVELOPMENTS

Automatic machine cuts with . . . sparks or ultrasonics—or both

Federici Ultraelectric ; British rep : Addison Tool Co Ltd, Addison Hse, 28 Marshalsea Rd, London SE 1. *Metalworking Prod* 1960 Vol 104 (12) p 520 (Mar 23)

Multi-purpose Italian machine, the Ultraelectric, which will cut the hardest metallic, semi- and non-metallic materials, is equipped for both spark and ultrasonic erosion. A vibrating electrode is employed during spark erosion. A further accessory permits hardfacing by spark deposition. 1 illustr.

X *Ceqm Pr/Ceqr Pr*

The physical fundamentals of electric spark working of metals

Anon. *Tooling* 1960 Vol 14 (3) pp 58-59 (Mar)

E *Bf Ceqm.21*

Spark erosion—a versatile method of machining metal. Die Funkenerosion—eine vielseitige Methode der Metallbearbeitung

Anon. *Maschinenwelt u Elektrotechnik* 1960 Vol 15 (4) pp 144-145 (Mar) (In German)

4 illustr. *K* *Bf Ceqm*

New way to machine carbides . . . . it's electron beam machining

Anon. *Carbide Engng* 1960 Vol 12 (2) pp 23, 26 (Feb)

See *Industr Diam Abstr* 1960 Vol 17 p A81 (Mar).

D *Bk Ceqm*

Oscillating electrolytic grinder

Hammond Machinery Builders Inc, Kalamazoo, Mich. *Carbide Engng* 1960 Vol 12 (2) p 36 (Feb)

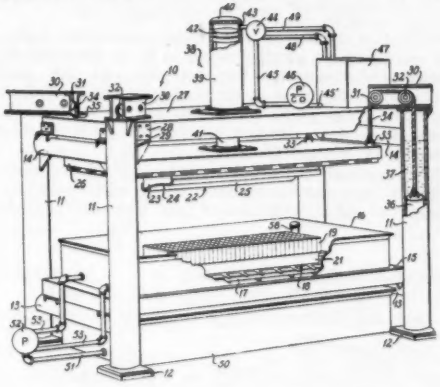
An oscillating electrolytic grinder features a bigger wheel and table for even larger work than previous models. The effort of manual tool oscillation is eliminated by the oscillating spindle and diamond wheel consumption is said to be reduced 80 to 90 per cent.

D *Nv Uqe/Psl Qn:Chcr Pr*

USP 2,908,797 (June 21, 1956) **R. E. Stegler, Republic Aviation Corp**

Means for and method of machining metals

The method refers to the electric spark machining of a profiled surface as shown in section in Fig 9. The metallic workpiece 19 is positioned on slats 21 supporting the already shaped side of the workpiece. A flat workpiece, not yet contoured, would rest on slats in a horizontal plane. The tool 22 is composed of a body 23, *eg* of synthetic resin, and a contoured metallic cap 25 covering the contoured surface 24. Workpiece



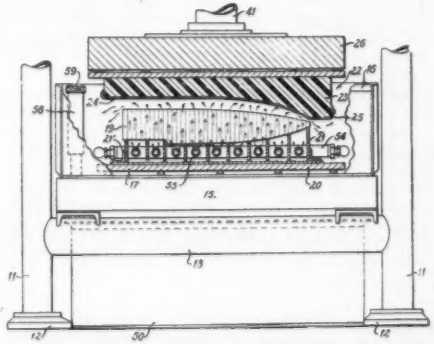


Fig 8 (top). Metering valve 44 is shown.

Fig 9. Sectional view of the method in operation. USP 2,908,797.

and tool are arranged in a tank 16 filled with dielectric fluid which is continuously circulated to remove the chips. A hydraulic actuator feeds the tool 22 towards the workpiece, the spark gap being maintained at its optimum by a metering valve 44 shown in Fig 8, dependent on the variation of the current flowing in the spark gap. The weight of the tool is balanced by counterweights 36 moving in oil filled columns. (9 claims, 4 illustr). Ref cited : 8 USP ; 1 BP.

J *Bf Ceqm.545*

USP 2,909,640 (Mar 10, 1958) **J. B. Fairbrother**

Electrical discharge machining apparatus

The apparatus permits the simultaneous drilling of a plurality of holes using individual electrode tools independently movable and angularly relative to each other but controlled as a unit. The workpiece may be symmetrical or non-symmetrical in configuration. The vertically movable worktable is arranged within a tank which also contains an annular tool support with a plurality of individual electrode tools mounted around the tool support. Each hollow electrode is slidable in a guide towards and away from the work moved by a single ring gear driven by a servo-motor mechanism. Dielectric coolant is supplied to the terminal tip of each hollow electrode. Each electrode can be fixed at selected radial distances from the vertical central axis of the coolant tank. (8 claims, 5 illustr). Ref cited: 1 USP. *J* *Az Ceqn Pr.545*

Swiss P 340,557 **J. F. Barry, N. C. Seeley, Western Electric Co**

(Dec 31, 1954—conv date, USA)

Method of cutting an electrically conductive body able to react with an electrolyte so as to be dissolved by the latter and apparatus for carrying out this method. Procédé de coupe d'un corps conducteur de l'electricité pouvant réagir avec un électrolyte de manière à être dissous dans ce dernier et appareil pour la mise an oeuvre de ce procédé

The method is suitable for producing accurately dimensioned semi-conductor disks with optically flat faces and of a thickness of less than 0.25 millimetre.

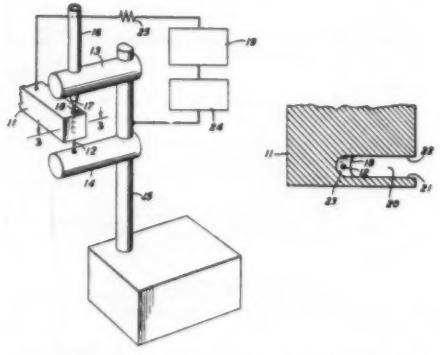


Fig 10 (left) and 11. Diagrams of the method showing electrode 12 in workpiece 11. Swiss P 340,557.

Hitherto such disks required a series of complicated machining operations including sawing, polishing and etching to remove mechanical or thermical tensions, so that only 5% of the original material usually remained in the finished product: the new method utilizes up to 50 per cent. It works with a thin rigid wire as electrode arranged adjacent to the workpiece which is then fed normal to the wire while an electrolyte flows down the wire, maintained on the active surface of the electrode in the space between wire and workpiece by adhesion and surface tension. Figs 10 and 11 show the arrangement magnified with the electrode 12 in the workpiece 11 and with the electrolyte 18 flowing from tube 16 through aperture 17 while an electric current passes through workpiece and electrode. (13 claims, 5 illustr). *J* *Bde Ceqn.545*

PRODUCTION, GRADING & RECOVERY OF ABRASIVE PARTICLES

Electronic measurement of particle size

H. E. Kubitschek (Argonne National Laboratory). *Research, Lond* 1960 Vol 13 (4) pp 128-135 (Apr)

A novel counter is described, which detects and sizes particles in suspension by means of their electrical resistance. The operation of the counter and its advantages over optical counters are discussed. Industrial applications are covered, among them the use of the Coulter Counter to evaluate or select machinery upon the basis of performance. For example, the counter was used to discover the most satisfactory of a series of grinders for reducing the solid lubricant molybdenum disulphide to particles of preferred size. One of the greatest advantages of resistance counting for industrial purposes is the extended range of the method, permitting accurate sizing of smaller particles than was possible with optical counters. 5 illustr, 5 ref, 1 table.

See also *Industr Diam Abstr* 1960 Vol 17 p A111 (Apr). *D* *Vgf W*

TOOL PRODUCTION

Metalworking report—More on Ti carbide

Firth Sterling Inc. *Amer Mach* 1960 Vol 104 (5) p 2 (Mar 7)

Cutting tools made of WF, a cermet with a titanium carbide base, molybdenum carbide additions, and a nickel binder, are claimed to give longer tool life at higher speeds than other tool materials in a number of applications. Examples are given of performance in operations in which neither regular carbide and ceramic tools were satisfactory. The titanium carbide tools are reported to have high temperature resistance coupled with high crater- and edge-wear resistance; other advantages are listed. *D* *Pdc.21*

New toolbits fill gap between HSS and carbide

DoAll Co, Des Plaines, Ill. *Amer Mach* 1960 Vol 104 (5) p 162 (Mar 7)

DoAlloy toolbits are made of a cast alloy cutting tool material that fills the gap between the maximum speed possible with HSS and the minimum speed practical with carbides. Generally they can be run at cutting speeds 50% to 100% higher than HSS. They are recommended for general purpose work on both ferrous and non-ferrous materials and are reported to be particularly advantageous at high speeds and heavy loads where considerable heat is generated. *D* *Pdb*Pdc*

What's happening to carbides?

P. M. McKenna. *Tooling & Prod* 1960 Vol 25 (11) pp 9-10, 12 (Feb)

A general article includes a section on high pressure uses. A typical application of tungsten carbide, resulting from its high rigidity and ability to resist deformation, is pressing chambers for transforming carbon to synthetic diamond. The increasing production of synthetic diamond is regarded as beneficial to the carbide industry since hard carbide alloys are best ground with diamond wheels, and as these become more plentiful, the cost of precision forming of tungsten carbide parts will fall; thus designers will have greater latitude in using carbides to make intricate components. *D* *Bk Ceq Fh/Fh Pdc.25*

Electrode materials

J. L. Adcock. *Metal Treatm* 1960 Vol 27 (174) pp 103-112 (Mar)

Surveys the range of suitable materials available for machining electrodes and considers their relative merits in respect of cutting properties and low wastage.

D *Ptc*

Precision turning. Genauigkeitsdrehen

Lohfert. *Technik u Betrieb* 1960 Vol 12 (3) pp 48-50 (Mar) (In German)

Factors involved in precision turning are discussed in detail. The materials uesd for the cutting tools are very important. Diamonds would be unsuitable, as they cannot be used at cutting speeds of less than 200 m/min, and the high cutting speeds involved would produce undesirable heat in the workpiece. Resistance to wear is essential and a list shows the appropriate sintered carbides for use with different workpieces. 5 illustr.

K *Ceqb Nf.21/Ceqb Pd.21*

The manufacture of planing tools. Die Herstellung der Hobelmeissel

Anon. *Technik u Betrieb* 1960 Vol 12 (3) yellow insert pages (Mar) (In German)

Cutting heads can be manufactured in two ways: either by forging and subsequent grinding, or completely by grinding. The heating necessary for the forging process, however, causes the steel to lose in hardness and for this reason the latter method is preferred. Aluminium oxide grinding wheels of medium hardness and with a grain size of 20 to 24 are most suitable. 2 illustr.

K *Cem Pd Qc*

Developments to watch . . . Now the Soviets steam their tools

Anon. *Prod Engng* 1960 Vol 31 (12) p 8 (Mar 21)

Reports from the USSR indicate that a steam treatment for cutting tools prolongs tool life three to six times and thus makes it possible to increase cutting speed. This treatment is said to create an oxide film on work surface which decreases friction and increases the effectiveness of coolant action.

D *Al Ckz.33*

American tool steels. Amerikanische Werkzeugstaehle

Anon. *Iron Age* 1959 Vol 183 (18) pp 109-119; abstr *Draht* 1960 Vol 11 (3) p 143 (Mar) (Original in English, abstr in German)

The properties of various tool steels are discussed and examples of the various applications given.

K *Rwz U.21.342*

Vitrified abrasive wheels: II, Relation between melting state and electrical conductivity of bonds

Y. Ito, E. Kato. *Nagoya Kogyo Gijutsu Shikensho Hokoku* 1953 Vol 2 (8) pp 29-36; abstr *J Amer ceram Soc* 1960 Vol 43 (3) p 51 (Mar)

The sintering and vitrification processes of feldspar bonds were studied by measuring the electrical conductivity.

D *Ab Cv.21*

Tools working at very much higher speeds are often more economical despite the resulting reduction in tool life. Des outils travaillant beaucoup plus vite sont souvent plus économiques malgré leur durée écourtée

H. W. Bredin. *Mach Mod* 1960 Vol 54 (612) pp 38-40 (Mar) (In French)

3 illustr, 3 tables.

K *Pd Uqe*

X-Ray orientation increases diamond life

Anon. *Metalworking Prod* 1960 Vol 104 (12) p 524 (Mar 23)

See *Industr Diam Abstr* 1960 Vol 17 p A82 (Mar).

D *F Ubcz*

Precision machinery for tool manufacture. Praezisionsmaschinen fuer den Werkzeugbau

K. Fluegel. *Feingeraetetechnik* 1960 Vol 9 (3) pp 125-129 (Mar) (In German)

6 illustr.

K *Pd Qc*

USP 2,907,148 (Oct 23, 1956) **V. L. Sheets, Chicago Wheel & Mfg Co**

Abrading wheels

Common methods for making so-called mounted abrading wheels include the step of mounting a mandrel individually in the pre-formed bore of each wheel. Such individual mounting leads to many rejects due to inaccurate alignment. Pressing the loose abrasive composition direct about the steel mandrel has not been feasible when using a vitreous binder requiring high temperatures (2,000° Fahrenheit). A composition with a lead borosilicate glass binder can however be compacted about a steel mandrel in the die and fired at a temperature around 1,200° F, which is sufficient to fuse the binder to effect binding of the abrasive particles and permanent union between wheel and mandrel. The mandrel in this instance can have an enlarged head for full 'interfacial' mating of the parts. The binder (30 to 50%) is a compound of silica, boric acid and red lead oxide. (2 claims, 7 illustr). Ref cited: 9 USP.

J *Ab Cs.545*

USP 2,909,417 **W. Osenberg, Bisterfeld & Stolting** (Dec 31, 1954—conv date, Germany)

Manufacture of single or multi-stage grinding rings or the like

Tubes or tubular sections are pre-formed from thermosetting resins or wound from impregnated layers and compacted for embedding the abrasive particles firmly. Known tube-winding machines operating with a rotating steel mandrel and heat and pressure rollers do not produce satisfactory results. The insertion of the tube or tubular section into a moulding tool and compacting the tubes or section by radial pressure with simultaneous heating using gaseous, liquid, or plastic hydraulic means produced by oil pressure, or with mechanically controlled ram, overcomes all difficulties. The building-up of grinding rings by winding impregnated layers results in a uniform distribution of the abrasive particles in the desired concentration, and, if desired, in zones separated from each other with or without embedded abrasive. (10 claims, 7 illustr). Ref cited: 8 USP; 1 BP.

J *Ab Urb:Qc.545*

Swiss P 340,727 **C. A. Redfern** (July 19, 1954; July 13, 1955—conv dates, Gt Britain)

Abrasive article and method of manufacturing this article. Article abrasif et procédé de fabrication de cet article

The abrasive grains (diamond, silicon carbide, boron carbide, spinel) are usually bonded with a phenol-formaldehyde resin. Such grinding wheels however suffer from (*i*) frictional heat which destroys the bond; and (*ii*) the rigid nature of the resin bond which gives it low wear resistance at elevated tempeartures. It has been found that polyphosphochloronitrides $(PNCl_2)_5$ and certain derivatives are excellent bonding materials for abrasive particles. (9 claims).

J *Ab Km Lld.545/Ab Rd:Cs.545*

DAS 1,066,449 **G. F. Keeleric, Boart Products South Africa Ltd**
(Nov 25, 1953—conv date, USA)

Face grinding wheel. Stirnschleifscheibe

Thin grinding disks containing diamond particles in a metal bond obtained by electro-deposition are not usually suitable for fine grinding work ; resin bonded wheels are preferred as they permit the grinding of sharp edges. The new wheel consist of carrier ring shown in Fig 12 and base Fig 13 and 14. The ring is

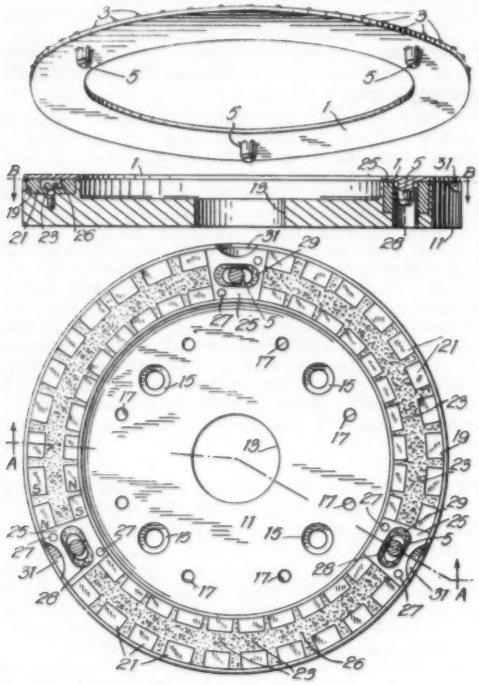


Fig 12 (top). The carrier ring.

Fig 13 (centre) and 14. Two views of the base. DAS 1,066,449.

made by embedding diamond particles 3 (exaggerated in the figure) arranged on a tacky surface in a thin copper layer of only several 0.01 mm thickness to which a nickel layer is then applied. The copper layer is afterwards removed to expose the diamonds. Pins 5 are then mounted on the ring. The base is a strong body of bronze, aluminium, or other non-magnetic material with a number of magnets 21 and brass inserts 25 with slots 29 containing rubber linings 28. This mounting permits slight movements of the ring relatively to the base resulting in soft grinding. The ring is easily exchangeable. (4 claims, 3 illustr). Ref cited : 1 GP ; 1 DBP ; 2 USP.

Nv Urb:Qec.545

LITERATURE REQUESTS
When applying for the loan of literature abstracted in this journal, please quote the title of the article, the name of the author, and the number of the page on which it appeared.

DAS 1,066,905 **F. L. Curtis, Deutsche Norton GmbH**
(Dec 17, 1956—conv date, USA)

Method of making grinding bodies, in particular grinding pencils. Verfahren zur Herstellung von Schleifkoerpern insbesondere Schleifstiften

The process is characterized by the direct spraying-on of the abrasive which is melted in the flame of the blow pipe without adding a special bonding material. This of course is only possible with abrasive having a sharply defined melting point and which do not

Fig 15. A magnified example of the grinding pencil. DAS 1,066,905.

decompose in the flame such as diamond or silicon carbide. Fig 15 is a magnified example of such a pencil. The abrasives are preferably fused crystalline metal oxides such as aluminium oxide, zirconium oxide, titanium oxide, *etc*, and the pencils may have a diameter of 1.7 mm to be used at 100,000 rev/minute. (1 claim, 4 illustr). Ref cited : 3 GP ; 2 DBP ; 1 DRGM ; 1 FP ; 1 GP Appl ; 1 GP extract.

J *Pec Qc.545*

DAS 1,067,330 (July 24, 1956) **F. Nagel**

Honing stone. Honstein

It has already been proposed to add metal grains to the usual resin bonded abrasive such as aluminium oxide. Pulverized or granulated metals have been mentioned, especially brass, aluminium, tin, lead or their alloys. It has been found that cast iron grains of a size between 0.15 and 1.0 mm produce the best results as a support to protect the abrasive grain against high pressure destroying the grain prematurely. The optimum seems to be an addition of 30% of the total weight increasing the life of the stone by 20 per cent. (1 claim). Ref cited : 1 FP ; 1 BP.

J *Pgk Qc.545*

POWDER METALLURGY

Machinable steel-bonded carbides

Sintercast Div, Chromalloy Corp, Yonkers, NY. *Engrs' Dig* 1960 Vol 21 (3) pp 133, 135 (Mar)

The difference beween the two available grades of Ferro-Tic S is explained. Both are produced by powder metallurgy, but the softer Ferro-Tic S-45 can be machined readily with any single- or multi-point cutting tool, while Ferro-Tic S-55 is suitable only for basic operations, *ie* sawing, turning, drilling : milling or tapping is not recommended. Both grades can be ground. Among advantages claimed are that intricate parts can be machined from blanks quickly and easily.

See also *Industr Diam Abstr* 1959 Vol 16 p A247 (Dec). *D* *Bkz Unp*

Powder metallurgy as a method of producing and investigating magnetically hard materials

A. B. Altman. *Izv Akad nauk SSSR Otd techn nauk Metallurg i Topl* 1959 Vol 4 pp 135-142 ; *Inhaltsverzeichnisse sowjet Fachzeits* 1960 Vol 9 (1) p 79 (Jan) (Original in Russian)

K *Ba Qc Qt*

DAS 1,067,354 (July 2, 1957) **G. J. Lelkes**

Method of producing bodies of pure corundum. Verfahren zur Hersteilung von Koerpern aus reinem Korund

Very pure alpha-aluminium oxide powder with not more than 0.001% impurities and a particle size of preferably 0.01 μ is shaped and then sintered at between 1,450 and 1,600° centigrade. The shaping step may be carried out by mixing the powder with 15% water and forming the mass in a water absorbing mould of plaster of Paris. The moulded body is then pre-sintered at between 800 and 1,100° C so as to be adapted to be ground and polished before the final sintering step. Cutting bits made by this method have been used for machining a steel cylinder of a tensile strength of 90 kg/mm² at a cutting speed of 500 m/min. The chip had a cross section of 0.5 × 0.05 mm². After 10 min the wear on the cutting edge was less than 0.1 millimetre. (4 claims). Ref cited: 1 GP; 1 USP; 2 period. 1951, 1956; 1 book Niederleuthner 1928.

J *Al Bbc Ckf.545*

MISCELLANEOUS

Czech machine tools. Tschechoslowakische Werkzeugmaschinen

J. Tlusty. *Industr Anzeig* 1960 Vol 82 (19) pp 285-287 (Mar 4) (In German)

Trends in Czech machine tool construction are discussed with examples of new types built in the past year. 10 illustr, 5 ref. *K* *Pr.326*

Comparison chart for solid-carbide burrs—I, II, and III

Anon. *Amer Mach* 1960 Vol 104 (5) pp 123, 125, 127 (Mar 7)

By reference to this comparison chart the user can obtain the same carbide burr from any of the 12 member firms of the Solid Carbide Tool Institute without confusion over catalogue designations.

D *Pdcz.513*

PUBLICATIONS RECEIVED

BOOK REVIEWS

Materials—Pt I: Steel and iron. Werkstoffe I. Teil: Stahl und Eisen

T. Ricken. Carl Hanser Verlag, Munich. 1959, 108 pp, illustr. (In German)

This book is intended as an introduction to the subject and no specialized knowledge is presupposed. The author limits himself to essentials, but a short bibliography is given at the end for those wishing to follow up their studies. All important aspects of the production of iron and steel are covered, but sections on steel tools and testing, in which special attention is given to ultrasonic testing, may be of particular interest.

K *Bfc Vwl.21.52/Bfd Vwl.21.52*

Precious stones and pearls. Edelsteine und Perlen

K. Schlossmacher. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1959, 340 pp, illustr, plates, indices. (In German)

Although revised and enlarged for the second edition, this remains a book for those interested in gemmology, rather than a work for the diamond technician. The book begins with a long general section, dealing mainly with the properties and identification of gemstones. In the specialist section, 38 pages are devoted to a full, though rather general account of the diamond, in which great attention is paid to the production and sale of diamonds. The final practical section considers briefly the different shapes and methods of shaping diamonds and other stones. The book is well illustrated, including two colour plates.

K *Bb.52/F.52*

PATENT LISTS

BRITISH

The Official Journal (Patents) 1960 (3707) (Mar 2)

833,494 NEWALL ENGINEERING CO LTD, and HOARE S. W. Dressing of grinding wheels.

833,538 COMPAGNIE DES MACHINES BULL. Supplying coolant to a dressing diamond or like tool in a grinding machine.

The Official Journal (Patents) 1960 (3708) (Mar 9)

834,037 MICROMATIC HONE CORPORATION. Flat surface grinding machine.

834,126 JONES & SHIPMAN LTD, A. A. and HOULDSWORTH, J. Method of and a machine for, the production of spiral grooves and the like in workpieces.

834,307 OPTICAL MEASURING TOOLS LTD. Methods and apparatus for indicating profiles.

834,351 ABRASIVE & METAL PRODUCTS CO. Abrasives.

833,951 HOFMANN, E. F. Surface grinders.

The Official Journal (Patents) 1960 (3709) (Mar 16)

834,676 NORTON CO. Coated abrasive segment and wheel containing same.

834,677 NORTON CO. Polishing devices and polishing wheels embodying such devices.

834,852 CORONEL, M. S. Diamond wheel dressing or truing tools.

UNITED STATES

Official Gazette 1960 Vol 751 (1-4) (Feb)

2,923,100 L. G. SIMJIAN, REFLECTION ELECTRONICS INC. Abrading device.

2,923,104 E. E. OLSON, R. C. TROW, KING-SEELEY CORP. Finishing apparatus.

2,923,106 P. U. REUSSER, HEALD MACHINE CO. Grinding machine.

2,923,108 P. J. KIRKMAN, M. S. TISLER, LIBBEY-OWENS-FORD GLASS CO. Apparatus for polishing glass sheets.

2,924,048 H. E. SIOESTRAND. Machine for balancing rotatable bodies.

2,924,050 L. H. BARRON. Diamond edged band saw.

2,924,329 H. W. COMPSON, WESTERN ELECTRIC CO INC. Wire finishing device.

2,924,751 K. INONE. Electric spark machining apparatus.

2,924,872 E. WILDHABER. Form-cutting tool.

2,924,873 J. R. KNOWLES, GULF RESEARCH & DEVELOPMENT CO. Thermally controlled coolant supply for metal cutting tools.

2,924,875 B. GISNER, F. J. O. W. OHLSSON, SANDVIKENS JERNVERKS AB. Sintered hard metal alloy.

2,924,910 A. W. KLOMP, PROCESS GEAR & MACHINE CO. Gear bore and tooth-flank concentricizing machine.

2,924,913 J. KLAR, M. L. KUNIHOLM, HEALD MACHINE CO. Grinding machine.

2,925,691 E. D. KIBBLE, McLOUTH STEEL CORP. Grinding machine.

SOUTH AFRICAN

Official Journal 1960 Vol 13 (4-7) (Jan-Feb)

622/59 HARD METALS LTD., N. C. POPE. Rock drill bits with inserted cutting formations.

59/3764 G. J. KELLER, J. B. AUST, T. W. FORBES, CARBORUNDUM CO. Abrasive wheel.

SWISS

Patentliste 1959 (24) (Dec); 1960 (1) (Jan)

343,555 J. E. TUSCHER, ETS SAFETY. Method of automatic machining by electric sparks a workpiece being a body of revolution provided with teeth.

343,556 J. PFAU, ATELIERS DES CHARMILLES SA. Charging circuit for a machine for cutting by electro-erosion.

343,648 G. W. LUCAS, GENERAL ELECTRIC CO. Hard metal alloy.

343,654 A. BRUEDER, SA ANDRE CITROEN. Device for measuring workpieces centreless ground or honed.

343,756 L. O. CARLSEN, R. F. PIGAGE, GLEASON WORKS. Machine for cutting toothed workpieces.

343,828 E. PFISTER-SCHNEEBERGER, W. SCHNEEBERGER AG MASCHINENFABRIK ROGGWIL. Grinding machine for spherical glasses.

343,829 W. STAEHLI. Machine for faceting jewels in series.

343,834 W. OSENBERG, BISTERFELD & STOLTING. Face grinding wheel.

343,835 T. HOVIE. Method of manufacturing abrasive products.

343,869 G. BARBOTTE. Machine for drilling fine stones.

344,008 A. RICKENMANN, REISHAUER-WERKZEUGE AG. Method and machine for grinding gear wheels.

FRENCH

Bulletin Officiel 1960 Vol 1 (5-8) (Feb)

1,220,372 J. R. QUINAN, J. W. SPRAGUE, NORTON CO. Material adapted as support for the application of abrasives.

1,220,607 H. -J. SCHULZ, H. SCHIERHOLT, H. PETZ, DEUTSCHE EDELSTAHLWERK AG, ALLGEMEINE ELEKTRICITAETS-GESELLSCHAFT. Method and device for machining metal workpieces which are good conductors by spark erosion.

1,220,611 NEW ALL ENGINEERING CO LTD. Control of dimensions in machine tools.

1,220,864 W. TIRASPOLSKY. Tool for earth drilling.

1,221,243 A. B. HILDEBRANDT, H. C. BRIDWELL, JERSEY PRODUCTION RESEARCH CO. Coring device.

1,221,905 V. MEYER, H. F. PAYER, MINNESOTA MINING & MANUFACTURING CO. Manufacture of rotary non-rigid abrasive structures.

1,222,867 J. V. SANTSCHI, PITTSBURGH PLATE GLASS CO. Device for drilling glass.

1,222,947 H. LINDEMANN, TH CALOW & CIE. Cutting tool, preferably of hard metal.

GERMAN

Patentblatt 1960 Vol 80 (8-11) (Feb-Mar)

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1,076,289 M. BRUMA, M. MAGAT, CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE. Device for spark erosion with an impedance in the D.C. charging circuit of the condenser.

1,076,469 W. THIEMIG, O. BAUKNECHT, ZAHNRADFABRIK FRIEDRICHSHAFEN. Device on gear grinding machines for longitudinally curved grinding of straight and helical gears.

1,077,099 G. F. KEELERIC, BOART PRODUCTS SOUTH AFRICA LTD. Device for applying abrasive grain onto a temporary carrier.

1,077,441 P. -F. WARNING, SENNHEISER ELECTRONIC F. SENNHEISER. Stylus for a precision tracer or a surface tester.

1,077,507 J. LOOMAN, H. HOFER, W. THIEMIG, ZAHNRADFABRIK FRIEDRICHSHAFEN AG. Device for truing profiled grinding wheels for grinding evolute gear wheels with helical teeth.

1,077,560 K. RAENTSCH, M. HENSOLDT & SOEHNE OPTISCHE WERKE AG. Device for compensation of the shift between the co-ordinate tables and the tool carrier of machine tools caused by differences of temperature.

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973,544 H. BRAITO. Fine honing apparatus.

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AUSTRIAN

Patentblatt 1960 Vol 57 (1-3) (Jan-Mar)

207,479 NV PHILIPS' GLOEILAMPENFABRIEKEN. Device for machining metals.

208,088 C. AGTE, R. KOHLERMANN, W. DUEBEL, VEB HARTMETALLWERK IMMELBORN. Highly wear resistant sintered material on the basis of aluminium oxide-heavy metal carbide and method for its production.

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208,605 R. WEHNER, R. KOHLERMANN, VEB HARTMETALLWERKIMMEL BORN. High percentage titanium carbide hard metal alloy and method for its production.

208,747 S. MESSERSCHMIDT. Ball grinding machine.

208,748 T. SACHS. Method of making grinding or cut-off wheels.

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I 253—Factors affecting the efficiency of resinoid-bonded diamond wheels, by R. G. Weavind (*IDR* 1959).

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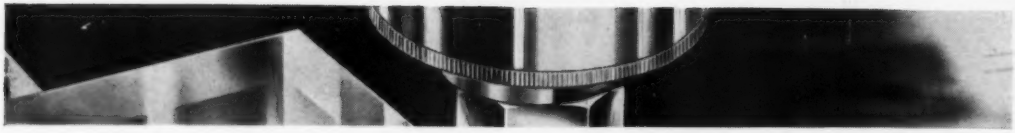

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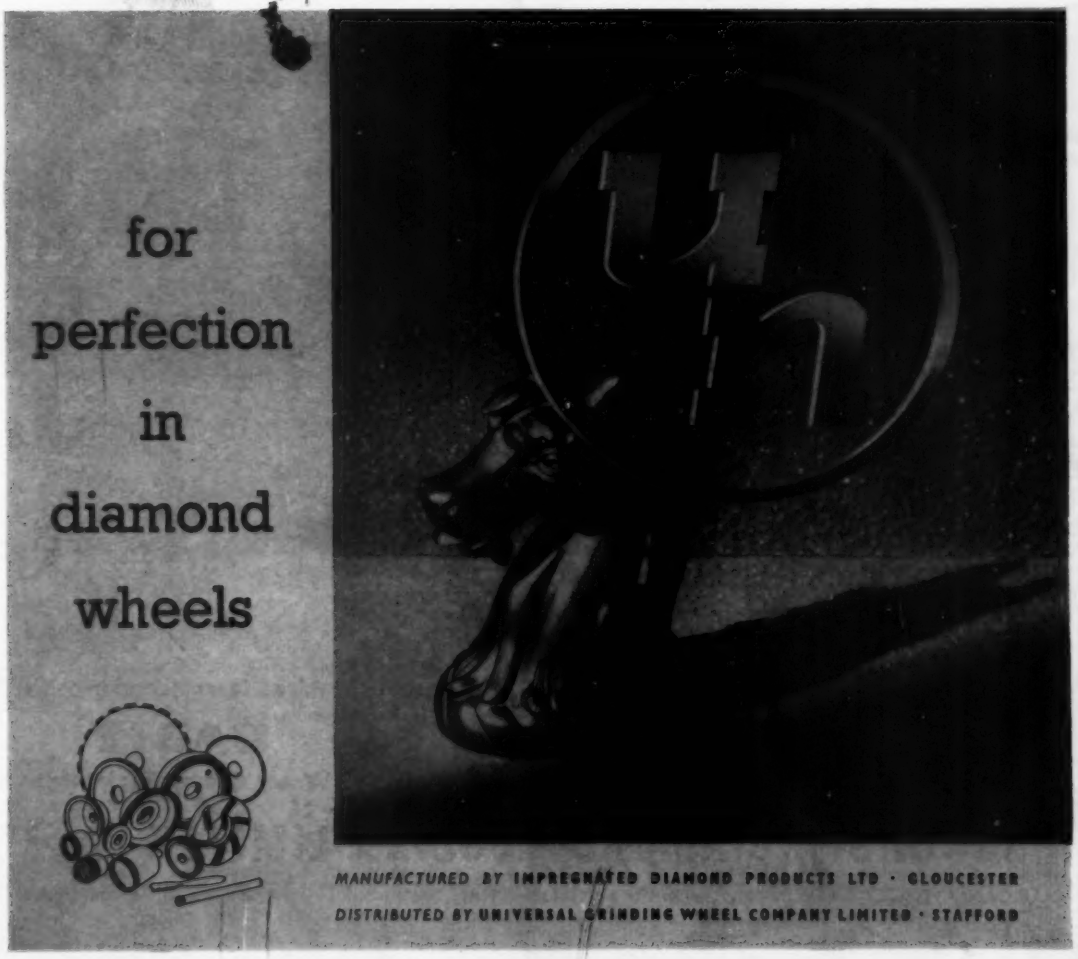
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